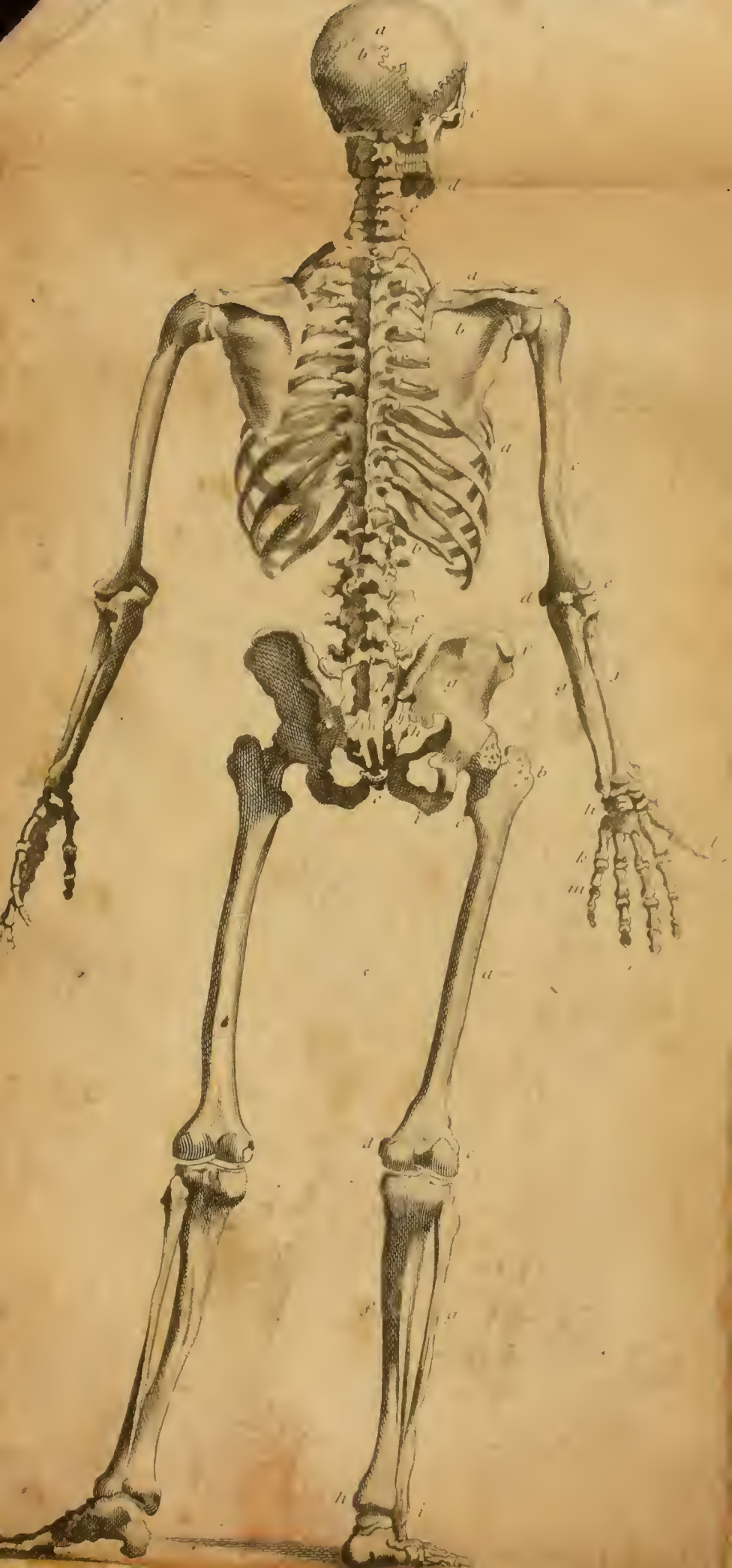






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ELEMENTS
OF
OSTEOLOGY.



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ELEMENTS
OF
OSTEOLOGY,
OR THE
MINUTE
ANATOMY OF THE BONES,
INTENDED FOR THE
USE OF STUDENTS,
SECOND EDITION,
CAREFULLY CORRECTED AND ENLARGED,

BY
HENRY KEMP RANDELL,
MEMBER OF THE ROYAL COLLEGE OF SURGEONS.

1831.

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1890



TO

RICHARD DUGARD GRAINGER, Esq.

DEAR SIR,

The kind intimation of your permission to dedicate the annexed elementary treatise on Osteology to the name of Grainger ! has afforded me the most sincere pleasure.

The rise and increasing reputation of the Webb Street School have constituted a new æra in the history of Anatomical pursuits, and given a renewed impetus to the cultivation of the knowledge, of the natural structure and diversified functions of the organs of the human frame.

The stimulus thus excited by the example of your inestimable and deeply lamented brother, has not been lost upon the minds

of the ardent and juvenile members of your numerous class. His memory is enshrined in indelible characters, in their grateful recollections, and his name will be enrolled with honour, in the future calendar of fame!

To *him* and *yourself* I am proud to acknowledge I owe all the information I possess, upon a subject so interesting to the conscientious and intelligent surgeon; and if under your fostering auspices, the present work should obtain a favourable reception among the younger members of the profession, I shall consider my labour amply repaid, and with feelings of unfeigned gratitude and the highest respect, subscribe myself.

Dear Sir,

Your obliged Pupil,

HENRY KEMP RANDELL.

PREFACE

TO THE SECOND EDITION.

The flattering reception this little Work has met with ever since its publication, and more particularly from the WEBB STREET SCHOOL, has encouraged the author to send forth a *Second Edition*; which has been carefully corrected and enlarged, and the description in many parts altered.

The study of Anatomy, easy as it is of acquirement, cannot be too simplified; and prolix and incomprehensive descriptions serve only to perplex and confound the stu-

dent, in this most noble and interesting of professional sciences. The organization of man, viewed in all its extensive and diversified forms, finds no parallel, and opens to us a wide field both for anatomical, physiological, and pathological research.

There is no part, however, of the human body more particularly deserving our attention than the *Osseous Structure*; where, if we examine the various arrangements of the bones, the manner in which they defend the vital organs, either by enclosing them within their cavities, or by affording them support: the diversity of mechanical principles, which are exemplified in their articulation, and the infinite variety of functions, which, by the addition of cartilages, ligaments, and muscles, (more immediately under voluntary controul) they are destined to perform,—we shall find an endless subject for contemplative admiration, and

be led to exclaim with the immortal Shakespeare,

“ What a piece of work is Man ! ”

An accurate acquaintance with the bones, as has been stated in the first edition, is as indispensable to the study of the ligaments and muscles, as the knowledge of these are to that of the vessels and nerves. Osteology is indeed so intimately connected with every other branch of anatomy, that the acquirement of the one is necessary to that of the other.

Nor is it less indispensable to the practice of Surgery ! From a defective knowledge of the human fabric, arise those deformities of limbs after fractures, which even in this great metropolis are almost daily presented to our notice ; not always resulting from the severity of those accidents, but from their having fallen into the

hands of individuals, who, from their ignorance of Osteology, and of the various relations the bones have with each other, are unable to treat them scientifically.

The sole intention of the author, in the publication of this edition, is to afford the Student, if possible, *a still more clear and familiar guide to the study of Osteology*; one, which it is hoped will enable him, with the assistance of the bones themselves, to obtain a complete knowledge of their peculiar characters. For this purpose he has avoided in *toto*, a tabular arrangement, and has preferred describing the parts in the order that they present themselves to the eye; so that the student may be enabled to trace them out unaided by a demonstrator. This was the method constantly followed by the late Edward Grainger, who in the morning of life, fell an untimely sacrifice to the intense ardour with which he devoted himself to the

cultivation of his profession ; *and likewise to the present moment, by the celebrated anatomist to whom this work is dedicated ;* whose happy method of communicating the knowledge he possesses, constitutes one amongst the least of those excellencies which render him so distinguished and valuable a teacher.

But while, at the same time, the author has been anxiously desirous of affording the student as clear and as succinct a description as possible, he trusts that it will be found to comprise all the anatomical peculiarities of each individual bone ; still he is far from arrogating to himself the idea that he has fully accomplished his task ; on the contrary, he is sensible that it has fallen into very imperfect hands. The hope, however, of being able to put the student in possession of such a guide, as may enable him to gain a knowledge of Osteology in

his closet, has overcome his own feelings of insufficiency to its performance, and he will therefore content himself with its resting, a *second time* upon its own merits.

To the articted apprentice he flatters himself that it will be found highly useful, inas-much as it may forward him considerably in the commencement of his dissections ; and thus a great deal of valuable time will be saved. And if on examination, it should prove worthy of attention, and calculated to assist in removing those difficulties, with which it is too frequently thought to be surrounded ; and to excite that interest which to an unreflecting mind, it appears at first sight divested of, he will consider his labour sufficiently rewarded ; and led to indulge the hope, that his exertions have not been altogether useless or ineffectual.

Rotherhithe, May 20th 1831.

THE OSSEOUS SYSTEM.

SECTION I.

In commencing the study of Osteology it is necessary that we should first make a few observations upon the general characters of the bones and their mode of connexion with each other, before we pass on to a minute anatomical description. In so doing, a rude heap of materials will present themselves to our notice, so irregular in their appearance, and so varied in their form, that a transitory glance might convey to the mind, the idea of the impossibility of their subserviency to any

thing like symmetrical order. In no part of the body, however, shall we find more perfect symmetry of arrangement than in the osseus structure (THE SKELETON); where we observe those apparently inorganic fragments fitted to each other with an almost inimitable degree of exactness, constituting, on the one hand, cavities for the reception and defence of the more important and vital organs; and on the other, a varied series of articulations, which in combination with those loco-motive agents, the muscles, are so necessary to the performance of a variety of graceful movements; and which, independently of the rational and intellectual powers bestowed upon man, so pre-eminently distinguish him in the scale of creation. The further we pursue this interesting study, our attention cannot fail of being struck with the incomparable adaptation of parts to their particular uses, the wisdom, the order, and regularity of the whole—and our minds impressed with the most reverential feelings of wonder and admiration.

➤ The number of bones thus constituting

the frame-work of the body is subject to variety, and is differently stated by anatomists. Monro, Soemmering, and others, maintain that they amount to two hundred and sixty; Meckel only to two hundred and fifty-three. Mr. Grainger, in his excellent work on General Anatomy, enumerates but two hundred and fifty-two, which may be regarded as the most accurate. He describes them as follows: "the head contains sixty-two bones, *viz.* eight of the cranium, fourteen of the face, eight of the ear, and thirty-two teeth. The trunk contains fifty-four, *viz.* twenty-four moveable vertebræ, four bones of the pelvis, twenty-four ribs, a sternum belonging to the chest, and one os hyoides, placed in the neck. The upper extremities contain seventy bones, *viz.* four of the shoulders, two of the upper arms, four of the forearms, and sixty of the hands, including sixteen of the carpus, eight of the metacarpus, thirty phalanges, and six ossa sesamoidea. The lower extremities contain sixty-six, *viz.* two of the thighs, six of the legs, and fifty-eight of the feet,

including fourteen of the tarsus, ten of the metatarsus, twenty-eight phalanges, and six ossa sesamoidea.”

62	of the head,
54	- - trunk,
70	- - upper extremities,
66	- - lower extremities,
252	Total of the body.

The difference in the number is owing to the period of life at which the enumeration is taken. Thus, we find that in childhood it is greatest, and *vice versa* in old age, when, from the long continuance of the process of ossification, many previously distinct pieces become consolidated into one.

The irregularity in the figure, length, and density of the various bones, when viewed in their separate and disarticulated state, has given rise to four distinct classifications, which are adopted by almost all modern writers on Anatomy. These classifications are arranged in the following order : 1. ossa longa vel cylindrica ; 2. ossa lata ; 3. ossa crassa ; 4. ossa mixta.

1. *Ossa longa vel cylindrica*, or long bones, are, as their name implies, distinguished by their length. They are divided into a body and two extremities, and belong, in general, to the parts destined for loco-motion; and are in fact so many levers, subjected to the various actions of the muscles. Hence we find them constituting the limbs in which we observe them decreasing in size from above, downwards; but at the same time increasing in number: a disposition which, as an excellent author* of descriptive anatomy scientifically remarks, “gives to the superior division of each limb the great extent of motion it enjoys, whilst it allows to the inferior and terminal ones, a variety of rapid movements, within restricted limits.”

2. *Ossa lata*, or broad bones, are generally nearly as broad as they are long, but vary in thickness. The greater part of them are hollowed; in other words, are convex on one side, and concave on the other; on which account they are better adapted for the purposes for which they were destined, *viz.* that of forming cavities for the reception

* Quain.

and protection of vital organs. The circumstance too, of their arched shape, increases their strength, and affords additional security to the parts they inclose. A few of the bones of the cranium and pelvis belong to this division.

3. *Ossa crassa*, or short and thick bones, are nearly equal in their dimensions. Their figure, which varies, is usually rounded or cuneiform, and is generally determined by that of the parts into whose composition they enter. They present a great number of articular surfaces, by which they are adapted to themselves and to other bones. Those of the vertebræ, carpus, and tarsus, are referable to this class.

4. *Ossa mixta*, or mixed and irregular bones, are so named from their not being distinguished by any particular form, but from their partaking of the characters of the two preceding classes. We shall hereafter, for convenience of description, speak of these bones as being divisible into a central portion, or body, and processes. Some of the bones of the cranium, as the sphe-

noid, temporal, ethmoid, and occipital, and those of the vertebræ and pelvis, belong to this class.

This, then, is the arrangement usually followed by anatomists, in reference to the bones in an unarticulated state. Before we proceed to their mode of junction, it will be necessary to make a few observations on the various projections and depressions, their external surfaces present.

The projections are distinguished by the terms of apophyses and epiphyses. The latter only exist in the earlier periods of life, when the process of ossification is incomplete.

The *apophyses*, or processes, are divided into the articular and non-articular. The former are designated according to their particular figures; thus, if they approach more or less to the hemispherical shape, they are called heads; if flattened and elongated, condyles; and, when assuming the form of teeth, serræ or dentations.

The non-articular processes present great variety in form and size; some of them project very considerably from the superfi-

cies of the bones, and are named from their supposed resemblance to particular bodies, from their relative position, or from their uses. Hence, in describing the bones, we shall frequently have occasion to speak of the coronoid, mastoid, styloid, coracoid, spinous, odontoid, transverse, pterygoid, orbitary, and trochanteric processes.

Those processes which are short, thick, and rough, are called tuberosities. Others which project but little from the bones, and are distinguished by their narrowness and length, are termed lines, ridges, and spines.

The principal uses of the apophyses are, to afford security and firmness to the joints, and points for the attachment of muscles. The more prominent they are, the greater will be the degree of muscular power exerted upon the bones, in consequence of the angle at which the muscle is inserted into the bone being increased, and the parallelism of the former with the axis of the latter, diminished.

The *cavities* of the bones, like the processes, are divided into the articular and non-articular. The articular vary in depth

and form. Those which are deep and have large brims, are termed cotyloid, and those which are shallow, glenoid cavities. When the depression has the form of a pulley it is designated trochlea, and the cavities which are conical are called alveoli.

The non-articular cavities are of two kinds, *viz.* the superficial and the deep. The former are only confined to the surface, but are numerous and various in their appearance. Those which are larger superiorly than inferiorly, are called fossæ, and are intended for the reception of soft parts, as the digastric and lachrymal fossæ. Some are formed for vessels and nerves, and these are termed furrows, grooves, &c.

The deep cavities, like the superficial, are in great variety and number, since they are met with in all parts of the bones. Some pass completely through the bones. These are called foramina, or holes, if the bones are thin, and canals or conduits if their passage is of great extent. These foramina are frequently formed by the union of two or more bones, as for example the foramen incisivum, the foramen lace-

rum basis, cranii posterius, and canalis palato maxillaris, passages for the transmission of blood-vessels and nerves. There are other cavities which, although they pass deeply, do not perforate the bones; and of these there are also two kinds. The first includes those which are found in the substance of the bones, having small apertures; hence they are called sinuses, as we observe in the frontal and sphenoid bones. Or if they are partitioned off into small spaces, they are denominated cells, as in the ethmoid bone, and mastoid process of the temporal bone. In the second kind are included the cavities formed for the transmission of the nutrient vessels of the bones; and of these, which differ in their capacities, there are three varieties. The first variety is common to the long bones, in which they form canals, commencing near the middle of the shaft by an aperture which is called the medullary foramen; they then take an oblique course into the interior or cancellated structure. They are also observed in the large irregular bones, as the ossa innominata, &c. The

second variety is confined to the extremities of the long, and surfaces of the short bones, which are rendered lighter and quite porous by the immense number of small openings leading into their internal spongy structure. In the third variety are included a vast number of minute pores, which are visible to the naked eye, even upon the surface of the compact structure. These, as well as those of the second variety are for the transmission of the vessels derived from the periosteum. The medullary foramina only give passage to vessels nourishing the interior of the bones, and derived from some neighbouring arterial trunk. The best specimens of the latter openings are seen in the femur, tibia; and humerus.

Having thus hastily glanced at the bones in an unconnected state, and spoken of their division, arrangement, and appearances, as usually given by anatomists, we shall reserve our observations on the exemplification of the advantages derived from their various forms, as displayed in the construction of the osseous frame, till

we have described them individually, and considered their mode of junction and connection with each other, either directly or indirectly, so as to constitute the skeleton.

OF THE ARTICULATIONS.

The junction of any two bones, of whatever form or character it may be, is generally distinguished by the term of articulation. If we carefully examine the skeleton we shall find that its articulations are almost as varied as they are numerous, and are all of them subservient to the different movements of the body. This part of anatomical investigation demands the most undeviating attention of the student, in consequence of its important relation to dislocation and fracture; and no man should think of commencing his practical career till he is perfectly acquainted with it, inasmuch as his ignorance may entail upon him irretrievable infamy and disgrace.

The articulations of the skeleton have been variously arranged by different writers. That arrangement however will be found the most useful which has reference

to the mobility and immobility of the joints and form of the articular surfaces. Accordingly the articulations have been divided into three classes, as follows ; A. synarthrosis, or the immoveable ; B. diarthrosis, or moveable ; C. amphi-artrosis, or mixed. Two out of the three classes admit of subdivisions, which latter possess two or more varieties and modifications. This arrangement will be better understood by referring to the annexed diagram taken from Mr. Grainger's Elements of General Anatomy, *page 381*.

TABLE OF THE ARTICULATIONS.

ARTICULATIONS	{	Synarthrosis	{	Sutura	{	Serrata	{	Dentata
		or				Squamosa		
	{	Immoveable	{	Gomphosis				
		Articulation		Schindylesis				
	{	Diarthrosis	{	Enarthrosis				
		or moveable		Arthrodia				
	{	Articulation	{	Ginglymus	{	Angular	{	Double
						Lateral		
						Trochoide		
		{		Amphi-artrosis				
	{		or					
	{		Mixed Articulation					

This Table comprises all the articulations of the skeleton. It will now be for us cursorily to point out the circumstances under which they are found. Their practical illustration will be further dwelt upon after having described the anatomical characters of the individual bones, and the manner in which they constitute the various joints.

A. SYNARTHROSIS, or the first species of articulation, is met with in the head and pelvis. It admits, as is exemplified by the foregoing diagram, of four subdivisions,—1. Sutura; 2. Gomphosis; 3. Schindylesis; 4. Symphysis.

1. *Sutura*, the suture or seam, exists, with a few exceptions, between the facial and cranial bones, and is formed by numerous eminences and depressions. It possesses two varieties, *viz.* the *sutura serrata* and *sutura squamosa*. The first characterized by alternate projections and recessions like the teeth of a saw, and hence the term *sutura serrata*, or true suture; abundant examples of which are seen in the union of the frontal, parietal, and occi-

pital bones. Some slight modifications of this suture have received the names of *sutura dentata* from the projections being tooth-shaped ; and *harmonia*, when the surfaces are merely placed in apposition, as in the superior maxillary bones, *vide* table. The second variety is distinguished by the bones being bevil-edged, which has given rise to the appellation of *squamous* or *false* suture, as in the junction of the os temporis with the os parietale.

2. *Gomphosis*, is that mode of connexion in which a conical surface is received into a cavity, and is best exemplified by the manner in which the teeth are lodged in the alveoli.

3. *Schindylesis*, is the union by furrowing, in which the ridge of one bone is received into the groove of another, as in the connexion of the vomer with the nasal lamella of the os ethmoides.

4. *Symphysis*, by some authors classed with the moveable or mixed articulations. It is however more correct to place it amongst the immoveable joints, inasmuch as the slight yielding motion it permits is

entirely depending upon the intervention of an elastic structure. The best examples of it are in the pubic and sacro iliac symphyses.

B. DIARTHROSIS, or the moveable articulations, are those in which the extremities only of the bones are in contact with each other; their contiguity being maintained by ligaments and fibrous structures. This is the most frequent and important kind of articulation in the whole skeleton. It principally exists between the cylindrical bones, both where they are united to each other, and to the trunk; also in the junction of the lower jaw and cranium, between the skull and vertebral column, between the articulating processes of the vertebræ; and lastly in the union of the ribs with the spine and with the sternum. In most instances of the moveable articulations the articulating surfaces are mutually adapted to each other, being either convex or concave; but there are modifications in their configuration which may be reduced to the three following varieties, 1. Enarthrosis; 2. Arthrodia; 3. Ginglymus.

1. *Enarthrosis*, or the connexion by ball and socket, the head or rounded process of one bone being received into the cavity of another, is better calculated for extensive motion than any other articulation. The best examples of it are in the hip and shoulder joints.

2. *Arthrodia*, or the connexion by flat surfaces, frequently a slight modification of enarthrosis, is best exemplified in the articulations of the carpus and tarsus.

3. *Ginglymus*, or the hinge joint, the most complicated of the three, is of two kinds, *viz.* the *angular* and the *lateral*. The angular is that in which one bone has a pulley-like surface, called *trochlea*, into which another bone is received; the purest examples of it are the elbow and knee joints. The lateral or rotatory ginglymus is formed by the cavity of one bone receiving the convex process of another. It admits, as we shall afterwards find, of a sub-division into *double* and *single*; it is double when one bone turns upon another in two distinct places, as in the radius rolling upon the ulna; and single *or trochlea*

when the motion is performed at a single point, as in the articulation of the atlas or first vertebra of the neck, with the odontoid process of the second. The motions permitted in the diarthrodial joints are considerably modified by these varieties, in the form of the articular surfaces which we have described. All the motions, however, according to Bichat, may be referred to four species : 1. The motions of angular opposition ; 2. of circumduction ; 3. of rotation ; 4. of gliding.

1. The motion of opposition, or the angular movement, can only take place between the long bones ; and the angles they describe with one another, when made to move in opposite directions ; as from flexion to extension, or from abduction to adduction, vary in size, according to the degree of separation and approximation. In some joints, as in the elbow and knee, only flexion and extension are permitted ; in others, as the hip, shoulder, and thumb, it is more general, allowing not only of the two former kinds of motion, but also of abduction and adduction, and of various degrees of motion intermediate to them.

2. Circumduction is the movement which is performed when the shaft of a bone describes a cone, the apex of which is placed superiorly ; the base being at the distal extremity of the bone. During the execution of this movement, which is most extensively permitted at the shoulder joint, the limb passes successively through the states of elevation, abduction, depression, adduction, and all the intermediate points.

3. Rotation is entirely different from circumduction, and is that movement in which the bone remains in the same place and merely turns on its axis. It is best developed in the ilco-femoral articulation.

4. The motion of gliding is more or less common to all the diarthrodial articulations ; but there are some joints as those of the carpus and tarsus, which have no other action.

C. AMPHI-ARTHRISIS, or the mixed form of articulation, resembles the synarthrosis, inasmuch as the bones are united by an intervening substance, and the diarthrosis by permitting sensible movements. The only true examples of this form of articulation

are the fibro-cartilaginous connexions of the bodies of the vertebræ. The amphiarthrosis may be said to be intermediate to the synarthrosis and diarthrosis.

Having briefly considered the general characters and peculiarities of the bones, and their mode of connexion with each other, we now pass on to *a minute anatomical description*. In so doing, we shall carefully endeavour to illustrate the principles we have advanced, and to render our demonstration of their anatomical features as clear and as accurate as possible.

SECTION II.

DESCRIPTION OF THE BONES OF THE
SKELETON.

There are two kinds of Skeletons, *viz.* the *natural* and the *artificial*. In both the animal frame is deprived of all its soft parts, with the exception in the former of its ligaments and cartilages, which surround and envelope its articulations, and which are quite sufficient to preserve the contiguity of the bones. In the latter they are completely denuded of those appendages, and their articulating processes and surfaces exposed by long continued maceration in water. They are then fastened to each other, by means of wires, pieces of tin, cork, leather, &c. and by various me-

chanical contrivances. The articulations and their different motions are equally preserved, and hence its superiority over the natural skeleton for the purposes of anatomical description.

The SKELETON is divided into three parts, *viz.* the *head*, *trunk*, and *extremities*.

BONES OF THE HEAD.

The head of the adult varies both in size and shape, but is generally of a spheroidal figure. It is broader posteriorly than anteriorly, compressed laterally, and is placed upon the superior part of the trunk, resting upon the vertebral column. Inferiorly it has a great many processes which render its appearance extremely irregular. It is divided into two parts, the cranium and face; the former consisting of eight bones, the latter of fourteen.

Of the bones of the cranium five are termed proper, and three common. The five proper, consist of the os occipitis placed posteriorly; two ossa parietalia upon the upper part and sides; and the ossa tempo-

run upon the sides of the ossa parietalia, and at the same time beneath them. They are called proper because they are considered as belonging to the head alone. The three common are the os frontis, placed anteriorly, and forming the whole of the fore-part of the cranium, and the os sphenoides and os ethmoides, which are completely hidden in the base of the skull. They are termed common as constituting a part of both the head and face. All these bones are connected together by various seams, or sutures, the principal of which, eight in number, are named from their figure, situation, and course, and are as follow :

- | | |
|--------------------------|--------------------------|
| 1. <i>The Coronal</i> | 5. <i>The Sphenoidal</i> |
| 2. — <i>Sagittal</i> | 6. — <i>Ethmoidal</i> |
| 3. — <i>Lambdoidal</i> | 7. — <i>Transverse</i> |
| 4. — <i>Temporal, or</i> | 8. — <i>Zygomatic</i> |
| <i>Squamous</i> | |

1. The *Coronal* is so named from the ancients wearing their garlands over that part. It commences about an inch behind the external angular process of the os frontis, ascends upwards and backwards,

till it reaches the top of the head; then descends downwards and forwards to the same point on the opposite side from which we began to trace it. It connects the back part of the os frontis to the fore-part of the ossa parietalia.

2. The *Sagittal* commences from the centre of the coronal; it passes in a straight direction, backwards, to the centre of the lambdoidal. It has been named *sagittal* from its lying between the two sutures like an arrow between the string and the bow. It connects the ossa parietalia to each other.

3. The *Lambdoidal*, so named from its resemblance to the Greek letter Λ , commences at the root of the mastoid process of the temporal bone; it passes obliquely upwards and backwards till it reaches the termination of the sagittal, it then descends downwards and forwards to the same point upon the opposite side. It connects the upper part and sides of the occipital to the back part of the parietal bones. The continuation of this suture to the base of the skull has been called *additamentum suturæ lamb-*

doidalis. This addition to the lambdoidal suture commences at the root of the mastoid process, that is, at the point from which the lambdoidal suture itself begins ; it then descends upon the inner and posterior side of that process, and passes forwards and inwards till it reaches the base of the skull; and it there terminates at the foramen lacerum basis cranii posterius. It connects the inferior and anterior part of the occipital bone to the posterior part of the temporal bone upon each side.

4. The *Temporal or Squamous*, commences also at the root of the mastoid process, at the point common to the origins of the lambdoidal suture, and its continuation, the additamentum suturæ lambdoidalis; it ascends in an arched direction above the temporal bone, then descends underneath the zygoma, passing backwards and inwards upon the inner side of the glenoid cavity of the os temporis, and terminates in its continuation at the base of the skull; this continuation receiving the name of *additamentum suturæ squamosa*. It connects the temporal bone on either side to the

parietal and sphenoid. It has received the additional name of *squamous*, from the upper edges of the temporal overlapping the inferior edges of the parietal bones, like the scales of fishes.

5. The *Sphenoidal*, which is very irregular in its course, is so named from its surrounding the sphenoid bone. It connects it to all the other bones of the cranium.

6. The *Ethmoidal* also surrounds the ethmoid bone, and connects it to the frontal and sphenoid bones.

7. The *Transverse* connects the frontal bone with the nasal, superior maxillary, ossa unguis, the ethmoid, sphenoid, and malar bones. It commences at the external angular process of the os frontis, crosses first one orbit between the bones of the head and those of the face; runs over the root of the nose, then traverses in a similar manner the other orbit, and finally terminates at the opposite external angular process of the os frontis.

8. The *Zygomatic* is a little suture which merely connects the zygomatic process of

the os temporis to the same process of the os male; forming an arch called the zygoma or yoke, under which the temporal muscle descends to its insertion into the lower jaw. There is *another* suture which is seldom mentioned, and is rarely seen in the adult, though always in the foetus and frequently in the female and in young persons. It has been denominated the *frontal*. It divides the os frontis into two equal portions. Commencing at the nasal process of that bone, it passes in a straight direction upwards and backwards to the sagittal suture, of which the latter may be said to be its continuation.

In the centre of the lambdoidal suture we frequently meet with detached bones, which have received the name of *ossa triquetra vel triangularia*, from their angular shape, or *Wormiana*, from *Olaus Wormius* who first described them. Their existence should be borne in mind, as they may be mistaken for fractures.

This description comprises the principal sutures connecting the cranial and facial bones together, and amongst them we find numerous examples of the first sub-division

of synarthrosis termed *serrata*, page 14. If the student is in possession of a skull in which the connexions of the various bones are well defined, he will observe that the coronal, sagittal, and lambdoidal sutures are true examples of the first variety of sutura which has been called *sutura serrata*; and in the course of the lambdoidal suture, particularly, he will find many little tooth-like projections, constituting that modification of the sutura serrata, which has been designated *sutura dentata*. The fourth cranial suture is an example of the second variety of sutura, called *sutura squamosa*, or *false* suture. The remainder, as well as several others not necessary to be mentioned, being of no practical importance, are specimens of the other modification of the sutura serrata, which has received the name of *sutura harmonia*, the edges of the bones being merely in contact.

OS FRONTIS.

This bone resembles in shape a cockle shell. It is situated at the anterior part

of the skull and superior part of the face, and hence its name. It is divided into two parts (frontal and orbitar), the one turned upwards and backwards, which is by far the largest portion to constitute the forehead, the other placed inferiorly, forming the roof of the orbits. Externally it is smooth and convex. Upon each side of the centre there are two prominences which point out the situation in which ossification first commenced in the foetus. Inferiorly the bone is contracted, and forms the superciliary ridges; each of these ridges are bounded by an external and internal angular process. Inclined a little to the inner side of the centre of these ridges are seen the foramina supra orbitaria; occasionally, however, there is merely a notch; they transmitting the supra orbitar blood-vessels and nerve. Nearer to the internal angular process on each side, than this foramen, there is a groove which transmits the tendon of the trochlearis, or superior oblique muscle of the eye, in its course to its insertion upon the tunica sclerotica. Above the internal angular processes there are two eminences,

which point out the situation of the frontal sinuses. Between the internal angular processes the nasal process is situated, projecting a little downwards, having a serrated edge upon each side for supporting more firmly the ossa nasi. Proceeding backwards from the external angular processes, the temporal ridge on each side commences, ascending in an arched direction upwards and backwards, and in the perfect skull it may be traced over the lateral portion of the frontal bone, about an inch and a half above, but parallel with the temporal suture, till it becomes lost upon the sides of the parietal bone. Below this ridge the bone recedes, or is somewhat excavated, forming a part of the temporal fossa. Proceeding also backwards from the superciliary ridges in an arched direction, are seen the orbital processes. At the outer part of each orbital process there is a depression or fossa lodging the lachrymal gland. Between the orbital processes themselves there is a space called the fissura ethmoidalis, into which the ethmoid bone is received. Underneath the nasal process there are two openings leading into the frontal sinuses.

The internal part of the bone is concave, and is slightly marked by the convolutions of the brain. There are also several grooves or sulci lodging the arteries of the dura mater. In the centre of it, anteriorly, the spine is situated, which commences at a small opening called the foramen cœcum. It is very prominent at its commencement, but as it ascends upon the under surface of the frontal portion of the bone it becomes less so, and finally appears to bifurcate or split into two; between which there is a groove formed. To the spine itself the falk major, or that large process of the dura mater which separates the hemispheres of the brain, is attached; and the groove formed by the bifurcation of the spine lodges the commencement of the superior longitudinal sinus. The fissure ethmoidalis is also seen internally, which as we have before stated, is occupied by the cribriform plate of the ethmoid bone. Around its margin there are several cavities, which form a part of the ethmoidal cells. In this margin may also be observed two foramina, the foramina orbitaria interna, anterieus et

posterius. These openings are common to the frontal and ethmoid bones, their contiguous margins contributing to their formation. The *anterior* transmits the nasal twig of the ophthalmic nerve and the anterior ethmoidal artery; and the *posterior*, the posterior ethmoidal artery and vein. Upon each side of the fissura ethmoidalis, the orbital plates or processes are situated, which are there convex, and in some parts semi-transparent; and have several irregular depressions, superiorly, corresponding with the cerebral convolutions. These processes support the anterior lobes of the brain.

The frontal articulates with twelve bones. Superiorly and posteriorly with the two parietal, laterally and also posteriorly with the sphenoid, and inferiorly with the ethmoid. Externally, on each side, it is connected by its external angular processes with the ossa malarum, anteriorly and inferiorly by the nasal process, and its serrated edges with the ossa nasi and nasal processes of the superior maxillary bones, and lastly with the ossa unguis.

OSSA PARIETALIA.

These bones are so named from their forming the walls of the cranium, although they equally constitute the roof, and by far the greatest part of the skull. They are much more exposed than the others, are the most frequently fractured, and the most easily trephined. When separated from the rest of the cranial bones, and approximated to each other, they form a very beautiful arch, united above by the sagittal suture. Each bone is quadrangular in shape, and is smooth and convex externally and concave internally. Rather to the lower side of the centre there is a prominence, indicating the point at which ossification first commenced in the fœtus. The superior, anterior, and posterior edges are all serrated, whilst the inferior terminates in a thin squamous plate, which is over-lapped by the squamous portion of the temporal bone. Upon the upper part of the bone, posteriorly, we find the foramen parietale transmitting a vein to the superior longitu-

dinal sinus. The concave surface of the bone is marked by depressions corresponding with the convolutions of the brain. There are also numerous sulci, or grooves, lodging the arteries of the dura mater. The situation of two of these, larger than the rest, ought particularly to be borne in mind, as they may be endangered in the operation of trephining; and if wounded, might produce a most alarming and fatal hæmorrhage. The largest of the two is placed opposite to the anterior and inferior angle of the bone, and lodges the *arteria meningeæ mediâ*, the great artery of the dura mater. The smaller lies just upon the posterior and inferior angle of the bone, and receives the posterior meningeal artery. In addition to these two, there is a small portion of a very large and deep groove, upon the extreme point of the posterior and inferior angle, which transmits a portion of the lateral sinus. When the upper edge of one bone is approximated with its fellow, a fourth, large but comparatively shallow groove, is formed between them, which takes the course of the sagit-

tal suture to its termination, and then becomes continuous with a similar groove upon the occipital bone. It transmits the continuation of the superior longitudinal sinus.

Each bone is connected above with its fellow : anteriorly, to the frontal ; posteriorly, to the occipital ; and inferiorly, to the sphenoid and temporal. The meeting of the frontal and parietal bones being imperfect in the child, there is a membranous space left, which, from its resemblance to the trefoil leaf, has been called *folliolum* ; and by the ancients, hypothetically, *bregma fons pulsabilis*, or beating fountain, the pulsation of the arteries of the brain being felt there ; and it was considered by them as a drain of moisture from the brain. In after-life this space becomes completely filled up by an ossific deposit, and very often we find a projection of the superior angle of one or the other of the parietal bones, interrupting in some degree, the coronal suture.

OS OCCIPITIS.

So named from its being placed in the posterior part of the skull, forming the occiput. The superior part of this bone has been said to be somewhat triangular in shape, and is externally smooth and convex. Below this triangular portion the external crucial ridges are situated, which are here formed of one perpendicular, and two transverse spines or ridges. To the superior transverse ridge, the trapezius, splenius capitis, and complexus muscles are attached ; to the inferior, some of the small rotators of the head. Upon the top of the perpendicular spine is seen the tuberosity, or occipital protuberance, to which the ligamentum nuchæ is attached ; and at the termination of the perpendicular spine we find the foramen magnum, which gives transmission to the medulla spinalis, the vertebral arteries, and sub-occipital nerves. Upon each side of this foramen, situated rather anteriorly, there is a convex articulating process, called condyloid, covered with a smooth surface, which is somewhat

oblong in shape, for connexion with the concave superior articulating processes of the atlas, or first vertebra of the neck. To the outer side of each process there is a rough surface for the insertion of the rectus capitis lateralis muscle. Behind the condyloid processes there are two foramina, called the foramina condyloidea posteriora, to distinguish them from two others, which are larger, placed anteriorly, the foramina condyloidea anteriora; each of the former transmit a vein to the lateral sinus, and a small artery to the dura mater; and the latter, the lingual nerves. More externally than the anterior condyloid foramina, and at the same time, somewhat behind them, there are two grooves, which terminate, anteriorly, in two excavations, assisting in the formation of the foramina lacera basis cranii posteriora, and transmitting the terminations of the lateral sinuses, which here form the commencement of the internal jugular veins. In front of the great foramen, the basilar, or cuneiform process is situated, passing obliquely upwards and forwards, having

a rough and spongy termination anteriorly ; by which it is connected with the body of the sphenoid bone. Its lateral margins are also rough, where they are contiguous to the petrous portions of the temporal bones. The internal part of the bone is divided into four nearly equal fossæ, by means of the internal crucial ridges, which are here formed of one perpendicular, and one transverse spine. The superior fossæ receive the posterior lobes of the cerebrum ; the inferior, the lateral lobes of the cerebellum. To the upper half of the perpendicular spine, the termination of the falx major is attached ; to the lower half, the falx minor ; and to the transverse ridge, the tentorium cerebelli. Upon the upper half of the perpendicular spine, there is a groove which receives the termination of the superior longitudinal sinus. Running along each transverse ridge there is another groove, of considerable size, transmitting the lateral sinuses. The internal perpendicular spine, like the external, terminates at the foramen magnum, and upon the sides of this foramen there are two grooves, which transmit the lateral sinuses, after they have

traversed the petrous portions of the temporal bones ; these grooves terminate anteriorly, in two excavations, which assist in the formation of the foramina lacerata basis cranii posteriora. Parallel with the extent of the foramen magnum anteriorly, we find the foramina condyloidea anteriora. The posterior condyloid foramina are seldom seen internally ; occasionally, however, one is. The anterior edge of the foramen magnum is considerably excavated, which excavation is continued along the basilar process, and receives the pons Varolii, medulla oblongata, and some important blood vessels.

The occipital articulates with six bones, *viz.* superiorly with the two parietal ; inferiorly, with the two temporal ; with the sphenoid bone by its basilar, and with the atlas by its condyloid processes.

OS TEMPORIS,

Situated at the lateral and inferior part of the cranium. To render its description more easy, it is customary to divide it into three portions ; one superior, called *squamous* ; another, posterior, rough and thick,

the *mastoid*; and a third, internal and intermediate, the *petrous*.

The *squamous portion*, situated as we have stated, superiorly, is externally smooth and convex, and its upper edge terminates in a thin plate of bone, which overlaps, in an arched direction, the inferior and lateral portion of the parietal bone. Projecting from the lower part of the squamous portion, we find, the zygomatic process, from which the masseter muscle arises, passing horizontally outwards and forwards, to be connected with a similar process of the os male, and thus the zygoma, or jugum is formed, underneath which, the temporal muscle passes to be inserted. If we examine this process carefully, we shall find that it arises by two roots, the anterior of which passes transversely inwards, and at the same time slightly backwards, and here forms the anterior boundary, or lip of the glenoid cavity; whilst the posterior passes horizontally backwards, to the extent of about half an inch, and then bifurcates into two others, *one* passing like the anterior root, transversely inwards, and slightly back-

wards, to form the posterior boundary of the glenoid cavity—this lip, however, is of less extent than the anterior, but is more prominent; the *other* continues to run horizontally backwards to the commencement of the squamous suture, thus completely forming an elevated line of demarcation between the squamous and mastoid portions of the bone. Between the root of the zygomatic process and the anterior portion of the squamous plate, the bone is hollowed, lodging the temporal muscle. Inclosed also between the radices of the same process, as we have just explained, is the glenoid cavity. This cavity is elongated in a slightly oblique direction from without inwards, and is divided into two unequal portions by means of the fissura Glasseri, which transmits the chorda tympani nerve, laxator tympani muscle, and gives attachment to the processus gracilis of the malleus, one of the small bones of the internal ear. This cavity is lined with an articulating surface, for connexion with the condyle of the lower jaw, which surface extends some way upon the root of the zygomatic

process, which is here rather prominent, and takes the name of *eminentia articularis*. It also slightly extends upon the vaginal process, a thin plate of bone descending, as we shall afterwards find, from the inferior surface of the *pars petrosa*, or petrous portion, and situated between the *fissura Glasseri* and the *carotid foramen*. That part of the cavity however, in front of the *fissura Glasseri*, is in the natural position of the jaw, only occupied by its condyle, the remainder lodges a portion of the parotid gland. The internal surface of the squamous portion is concave, and is slightly marked by the convolutions of the brain; there are also several small sulci lodging branches of the arteries of the *dura mater*.

The *mastoid portion*, situated below, and posteriorly to the squamous, consists of a nipple-shaped projection or process, bounded inferiorly by an angular border. It is rough externally, where it gives origin to the *sterno-cleido-mastoideus*, *splenius-capitis*, and *trachelo-mastoideus* muscles. Behind and to its inner side there is a depression, or groove, which it overhangs as it were,

and which has received the name of fossa digastrica, from its giving attachment to the posterior belly of the digastricus muscle. At the root of this process, posteriorly, and about half an inch higher than the fossa digastrica, there is a hole which has received the name of foramen mastoideum; it transmits a small vein to the lateral sinus, integuments of the head, or an artery to the dura mater. Opposite to the process itself, internally, (that is upon its internal surface,) there is a large and deep groove, which transmits a considerable portion of the lateral sinus, just before it runs a second time upon the occipital bone, to make its exit from the skull.

The *petrous portion*, situated internally and intermediate, the greatest part, however, projecting internally, is so named from its peculiar hardness. It is said to form a triangular pyramid, having three surfaces, an anterior, posterior, and inferior. The base of this pyramid is placed externally, whilst the apex takes an oblique course, forwards and inwards to the base of the skull; it contains the in-

ternal ear, and has several holes transmitting the blood vessels and nerves of that organ, which we shall presently describe. In the base between the posterior part of the glenoid cavity, and the mastoid process, the meatus auditorius externus is situated, leading forwards, and inwards to the tympanum. Upon the inferior surface of the petrous portion we find two processes, the vaginal, before mentioned, and the styloid; the former, a thin plate of bone, separating the carotid foramen from the glenoid cavity; the latter, immediately behind the vaginal, and rather more externally; and if the skull be referred to, it will be seen that the root of this process is actually in contact with the additamentum suture lambdoidalis. It has been named styloid, from its supposed resemblance to the stylus, or point, with which the ancients engraved their writings on tablets of wax. It remains cartilaginous for many years after birth, and gives origin to three distinct muscles, *viz.* the stylo-hyoideus, stylo-pharyngeus, and stylo-glossus. Between this process and the mastoid, the foramen

stylo-mastoideum is placed ; transmitting the portio dura of the seventh pair of nerves. Upon the inner side of the vaginal process, and rather in advance of it, there is a large opening, called the foramen caroticum, which leads into a winding canal, the canalis caroticus. This canal passes upwards, forwards, and inwards, and terminates by an irregular opening just beneath the apex. It transmits the internal carotid artery, and a branch of the sixth pair of nerves, which, uniting with the vidian nerve, is described by some anatomists as here forming the commencement of the great sympathetic. Behind, and to the outer side of the foramen caroticum, there is a small but deep excavation, which has received the name of fossa jugularis. It lodges the termination of the lateral sinus, which here forms the commencement of the internal jugular vein. In front of the termination of the canalis caroticus, but between it and the spinous process of the sphenoid bone, there is an irregular opening from the Eustachian tube, or the iter a palato ad aurem, leading from the

pharynx to the tympanum. Upon the anterior surface of the petrous portion, there is a small opening called the foramen innominatum, transmitting the nervus innominatus; there is also an eminence, indicating the situation of the superior semicircular canal of the internal ear. Upon the posterior surface there is a larger opening, the meatus auditorius internus, or foramen auditivum internum, transmitting the seventh pair of nerves and the internal auditory artery. Behind, and to the inner side of this, there is an irregular excavation, which assists in the formation of the foramen lacerum basis cranii posterius. Above the meatus auditorius internus there are one or two small openings, leading from the aquæ-ducts of Cotunnus. Both the anterior and the posterior surfaces are irregularly convex, where they are opposed to the middle lobes of the brain and to the cerebellum. Upon the upper part of the petrous portion there is a sharp ridge, to which the tentorium cerebelli is attached; and upon this ridge there is a groove (in some subjects more distinct than in

others), lodging the superior petrosal sinus.

The temporal bone is articulated superiorly to the parietal, by the squamous suture, to the back part of the sphenoid, by the additamentum suturæ squamosæ, and to the occipital by the additamentum suturæ lambdoidalis, anteriorly to the malar bone, by the zygomatic suture, and inferiorly by the glenoid cavity, to the condyle of the lower jaw.

OS ETHMOIDES

Situated beneath the frontal, and in front of the sphenoid bone, is of a cuboid figure, but not solid, being exceedingly light, and consisting of several convoluted plates, which form a kind of net-work, not unlike a honey-comb. It is curiously enclosed between the orbital processes of the os frontis. Upon its upper part there is a sieve-like structure, which has received the name of cribriform plate and through the apertures of this plate, the filaments of the olfactory nerves pass to be distributed to the nose. The whole bone appears to consist of one perpendicular lamella, and of two

equilateral portions. The perpendicular lamella projects anteriorly above the cribriform plate, and divides it into two portions. This projection has received the name of *crista galli*, from its resemblance to a cock's-comb, and to it the *falx major* is attached. The perpendicular lamella also descends inferiorly to form the nasal lamella, which, meeting with the vomer and nasal cartilage inferiorly, with the *processus azygos* of the sphenoid bone posteriorly, and with the *ossa nasi* and nasal spine of the frontal bone anteriorly, complete the *septum narium*. In front of the *crista galli*, there is a small notch or excavation, which, when the bone is united to the frontal, forms the *foramen cœcum*. Upon the sides of the nasal lamella, inferiorly, the *ossa spongiosa superiora* are placed. These bones hang down from the sides of the *septum narium*, and are each rolled up like a scroll of parchment. The lateral portions are externally, remarkably thin, semi-transparent, and smooth, and this smooth portion, which has received the name of *os planum*, forms a considerable part of the

inner side of the orbit. Between it and the os spongiosum superius, on each side, there is a large cavity, extending superiorly as high as the cribriform plate, which is called the ethmoidal sinus. Between the ossa plana and the orbital processes of the os frontis, there are two openings upon each side, or rather excavations, being only complete when the bones are in contact with the frontal; which are called the foramina orbitaria interna anteriora et posteriora, and are the same as were alluded to in describing that bone. In front of the ossa plana there are some small cavities separated from each other by thin bony septa, which, when the bone is articulated with the os unguis of either side, are completely hid from view; they are called the anterior ethmoidal cells.

The ethmoid bone is articulated with thirteen bones; superiorly with the frontal, where it is received into the ethmoidal fissure; posteriorly, with the processus azygos of the sphenoid bone, and with the palate bones; anteriorly with the nasal bones, and anteriorly and laterally

with the ossa unguis, and nasal processes of the superior maxillary bones ; and inferiorly with the vomer and inferior spongy bones.

OS SPHENOIDES

Completes the cranium, and closes it below. It is also named cuneiform, or wedge-like bone, from its being wedged in between all the other bones of the cranium. In shape, it is thought to resemble a bat with its wings extended, and certainly the resemblance is still more striking when the ethmoid bone is attached to it ; the temporal processes forming the wings, and the pterygoid the feet, its middle constitutes the body, and the ethmoid answers to the head. It is on account of this resemblance, that it is frequently called the pterygoid bone. It is usually divided into a central portion, or body and processes. The body is much excavated, to receive the pituitary gland ; this excavation, which has received the name of sella turcica from its resemblance to a Turkish saddle, is bounded anteriorly and posteriorly, by what are called

the anterior and posterior clinoid processes. The two anterior arising from the fore part of the body of the bone, are widely separated from each other, whilst the posterior, arising from a common base, afterwards diverge, and thus they differ from the anterior. Proceeding transversely outwards from the anterior clinoid processes, we find the transverse, spines to which the tentorium cerebelli is attached. Upon each side of the body, the alæ or wings, are situated, which are excavated, for partially supporting the middle lobes of the cerebrum. Each alæ possesses three processes, an orbital, temporal, and spinous. The orbital is placed anteriorly, and forms a considerable portion of the outer part of each orbit. The temporal is placed externally, forming a part of the temporal fossa, occupying the space between the frontal, malar, parietal, and temporal bones, and by meeting the former and two latter of these bones, by a thin scaly edge, it forms a part of the squamous suture. The spinous is placed posteriorly, and sinks in under the petrous portion of the temporal bone. Upon the back part of the body of

the sphenoid bone there is a rough surface, by which it is connected with the cuneiform process of the occipital bone. In front of the anterior clinoid processes there are two large and round openings, called the foramina optica. Each transmits the optic, or second pair of nerves, and the ophthalmic arteries to the eye. Between the transverse spines and alæ of the bone there are also two very large and irregular openings, the foramina lacera orbitalia superiora, transmitting the third pair of nerves, the fourth pair, the first division of the fifth pair, called the ophthalmic, and the sixth pair; and also the ophthalmic veins. Immediately behind and below these last openings we find two smaller ones, the foramina rotunda, which transmit the second division of the fifth pair of nerves, called the superior maxillary. Still more externally and posteriorly to the body, are the foramina ovalia, transmitting the third division of the fifth pair, called the inferior maxillary; and, last of all, the foramina spinosa, giving passage to the middle meningeal arteries. Upon the back part of

the sella turcica there is a groove on each side, in which the internal carotid arteries pass, to get into the cavernous sinuses. At the roots of the anterior clinoid processes there is a prominence called the processus Olivaris, which separates the optic nerves from each other; and in front of it there is a small transverse groove, in which is received the commissure of the optic nerves. The centre of the bone, anteriorly, has a projecting process, which has received the name of processus azygos. This process articulates with the vomer and nasal lamella of the ethmoid bone, and so forms a part of the septum narium. Upon the sides of it there are two thin plates of bone, which from their shape have been called ossa triangularia, and on removing them we expose the sphenoidal sinuses. These sinuses are two large cavities occupying nearly the whole of the body of the bone, being merely separated from each other by a thin bony septum. Proceeding perpendicularly downwards from the inferior surface of the bone, at the line of junction between the body and alæ, there are ^{two} ~~too~~ large

processes, which have received the name of pterygoid, situated on each side of the azygos process, and rather posterior to it. These processes consist of an internal and external pterygoid plate, and hence they are often described as four processes. The plates themselves are united at an angle anteriorly, and diverge behind so as to form an angular groove. Of these, the internal are much the largest, being both longer and narrower than the external; each terminates in an hamular or unciform process, upon the extremity of which there is a pulley receiving the tendon of the tensor palati muscle. The external plate is turned outwards, whilst at the same time, it projects farther back than the internal, it bounds the pterygoid fossa and gives origin to the external pterygoid muscle. At the root of the internal pterygoid plate, there is a slight depression called, fossa navicularis, which gives origin to the tensor palati muscle. In the groove between the two plates, arises the internal pterygoid muscle; and in the triangular space left at their inferior divergence, the pyramidal process

of the palate bone is received. In addition to the foramina placed internally, which we have already described, there are two others which are situated at the roots of the pterygoid processes, and which are not seen at all upon the internal surface of the bone, called foramina pterygoidea; they lead into the pterygoid canals, which pass above the pterygoid processes, running horizontally from before backwards, and transmitting small branches of arteries and nerves.

The sphenoid bone is articulated posteriorly by its body, with the basilar process of the occipital bone, and anteriorly with the ethmoid. By the anterior and lateral edges of its alæ with the orbital processes of the frontal bone; by the superior and posterior edges of its alæ with the parietal and squamous portions of the temporal bones; and by its spinous processes with the petrous portions of the same bones. With the malar bones by the external edges of its orbital processes, with the palate bones by its pterygoid

processes and, lastly, with the vomer, by its azygos process.

Having described the bones of the cranium separately, we shall now give a general repetition of the parts, in the order that they present themselves at the *external* and *internal* basis of the skull.

Of parts seen at the Internal base.

Anteriorly, and in the centre, we first find the crista galli of the ethmoid bone, having upon each side the cribriform plate of the same bone, and still more outwardly and laterally, the orbital processes of the os frontis, with their irregular elevations and depressions, corresponding with the cerebral convolutions. About an inch and a half behind the root of the crista galli, but still in the centre, the sella turcica is situated, bounded anteriorly and posteriorly by its anterior and posterior clinoid processes. Descending from its root is the cuneiform process of the occipital bone, abruptly terminating at the foramen magnum. Beyond the foramen magnum are

the crucial ridges, formed by one perpendicular and one transverse spine. Upon the sides of the sella turcica there are two large cavities, which are bounded anteriorly by the transverse spines and alæ of the sphenoid bone; and, posteriorly, by the petrous portions of the temporal bones. These cavities contain the middle lobes of the cerebrum. Between the petrous portions of the temporal bones and transverse ridge of the occipital, there are two others, which receive the lobes of the cerebellum. The space above the transverse ridge of the occipital bone and petrous portions of the temporal bones is wholly occupied by the posterior lobes of the cerebrum.

Of the principal Foramina seen Internally.

Anteriorly to the anterior clinoid processes of the sphenoid bone, we first find the foramina optica, transmitting the second pair of nerves, or optic and ophthalmic arteries to the eye. Between the transverse spines and alæ of the same bone, the foramina lacera orbitalia superi-

ora are situated, which give passage to the third pair of nerves ; the fourth pair ; the first division of the fifth pair ; and the sixth pair of nerves ; and also the ophthalmic veins. Behind these openings, we find the foramina rotunda, transmitting the second division of the fifth pair of nerves, called the superior maxillary. Still more posteriorly and laterally than the foramina rotunda, are the foramina ovalia, transmitting the third division of the fifth pair, called the inferior maxillary ; and lastly, the foramina spinosa, through which the middle meningeal arteries enter the skull. Next in order are the irregular openings, between the petrous portions of the temporal bones and body of the sphenoid, transmitting the internal carotid arteries. Upon the back part of the petrous portion of each temporal bone, the foramen auditivum internum is situated ; giving passage to the seventh pair of nerves, called auditory ; and also the blood-vessels of the internal ear. Between the back part of the petrous portions of the temporal bones and sides of the occipital, the foramina

lacera basis cranii posteriora are situated; which transmit the par vagum, or eighth pair of nerves, also the accessory nerves, and internal jugular veins. To the inner side, and somewhat below these openings, we find the foramina condyloidea anteriora, transmitting the ninth pair of nerves. Lastly, we have the foramen magnum, through which the medulla spinalis, with its vessels and membranes leave, and the vertebral arteries and accessory nerves enter the skull. In addition to this description of the principal foramina, there are several smaller ones, worthy of notice. The first of these is the foramen cœcum, situated immediately in front of the crista galli of the ethmoid bone; between it and the spinous process of the os frontis, it transmits a small vein, which forms the commencement of the superior longitudinal sinus. On each side of the crista galli are the cribriform foramina of the ethmoid bone, which give passage to the small filaments of the first pair of nerves, called the olfactory. Between the temporal and sphenoid bones, on the inner side of the

fissures for the internal carotid arteries, there are two small and irregular openings called the foramina lacera basis cranii anteriora. These openings in the recent subject are nearly closed by cartilage; but they transmit the vidian nerve after it has passed backwards, through the pterygoid foramen, in the base of the process of the same name. Between the contiguous edges of the petrous portion of the temporal bone, and also of the sphenoid, upon each side, there is a groove which leads backwards and outwards, and lodges the cartilaginous part of the Eustachian tube. Upon the fore part of the petrous portions of the temporal bones we find two small openings, called the foramina innominata, transmitting the nervi innominati; and lastly, upon the back part of the petrous portions, two very minute openings from the aquæducts of Cotunnus.

Of parts seen at the External base.

In the centre, anteriorly, the nasal lamella of the ethmoid bone is situated; and upon each side of it, the cribriform plate

of the same bone. Upon the sides of the nasal lamella, but rather more outwardly, the superior spongy bones, and still more externally, the ethmoidal cells, ossa plana, and the orbital processes of the os frontis. In the centre, but more posteriorly than the nasal lamella, the azygos process of the sphenoid bone is situated, and upon each side of it the pterygoid processes, and still further outwards, portions of the alæ of the bone. More externally than the latter, are the zygomatic processes of the temporal bones, overhanging, as it were, the temporal fossæ. In a line, posteriorly with the processus azygos, the basilar process of the occipital bone is situated; and at the termination of this process, the foramen magnum, having upon its anterior margin the condyloid processes. Upon the sides of the basilar process, the petrous portions of the temporal bones are situated; more laterally, the glenoid cavities of the same bones; and more externally and laterally than these, the styloid, mastoid, and vaginal processes. Posteriorly to the foramen magnum, are the crucial

ridges formed of one perpendicular and two transverse spines ; the former terminating in the posterior extremity of the base of the skull, at the tuberosity of the occipital bone.

Of the Foramina seen externally, which are not visible internally.

The first are the foramina pterygoidea, situated at the roots of the pterygoid processes. Immediately in front of the foramen caroticum, on each side, between it and the spinous process of the sphenoid bone, there is a small fissure from the Eustachian tube. This fissure may be traced in continuation with the groove which was spoken of when describing the foramina of the internal base. Just upon the inner side, and a little in advance of the vaginal process, the foramina carotica are situated, leading into the carotid canal, and terminating in an irregular opening upon the under and fore part of the petrous portion of the temporal bone, so as to appear continuous with the grooves upon each side of the sella turcica ; consequently the carotid arteries do not directly perforate the base of the skull, but

follow the tortuous course of this bony channel before they mount up into the brain. Upon the outer and back part of the glenoid cavity on each side, the opening of the meatus auditorius externus is situated, which is circular in the child, and oval in the adult, its greatest diameter being from above downwards. At the roots of the mastoid processes posteriorly, we find the foramina mastoidea transmitting veins to the lateral sinuses. On the inner side of the vaginal processes, between them and the styloid, the foramina stylo-mastoidea are placed, transmitting the portic dura of the seventh pair of nerves. Behind the condyloid processes of the os occipitis, are the foramina condyloidea posteriora, transmitting small veins to the lateral sinuses or an artery to the dura mater; and lastly, in the orbits, there are two small openings, which were spoken of when describing the ethmoid and frontal bones, and which are situated upon the inner side of each orbit, called the foramina orbitaria interna anteriora et posteriora, transmitting small branches of arteries and nerves.

*Of the course of the superior longitudinal
and lateral sinuses.*

The superior longitudinal sinus commences by a small vein, which emerges at the foramen cœcum; it runs along the spine of the os frontis, and beneath the sagittal suture, in the groove formed by the union of the parietal bones; it then descends upon the upper half of the perpendicular spine of the occipital bone, and finally terminates in one of the lateral sinuses, generally in the right lateral.

The lateral sinus of either side commences from the termination of the superior longitudinal; it runs along the transverse ridge of the occipital bone, then upon the posterior and inferior angle of the parietal; from this it passes upon the petrous portion of the temporal bone, opposite to the mastoid process, and a second time it gets upon the occipital by the side of the foramen magnum, and eventually leaves the skull at the foramen lacerum basis cranii posterius, enters the fossa jugularis, and there forms

the commencement of the internal jugular vein. These sinuses receive the blood from all the other sinuses of the brain, and from those situated at the base of the skull.

This then completes the description of the bones of the cranium, and of the parts seen at the external and internal basis of the skull. We now pass on to the second part of our subject, and proceed to describe the

BONES OF THE FACE.

The bones of the face are placed immediately beneath the os frontis, and the greater part of them are grouped together under the common name of upper jaw. They are, as we have before stated, fourteen in number, and are usually divided into six pairs, and two single bones ; as follows :

<i>Two ossa nasi,</i>	<i>Two ossa malarum,</i>
— <i>unguis,</i>	— <i>palati,</i>
— <i>maxillaria superiora,</i>	— <i>spongiosa inferiora.</i>

These constitute the six pairs. The two single bones are, the *vomer* and the *os maxillare inferius*.

All these bones are united to the cranium and to each other by various sutures, which have received names from their position and the course which they take, but they are only so many specimens of the *sutura harmonia*, their edges being merely in apposition, and as they are of no practical utility, we shall pass over them, and proceed to describe the

OSSA NASI.

These bones are situated in the upper part of the face, immediately beneath the centre of the *os frontis*, and between the nasal processes of the superior maxillary bones. They are convex externally from side to side, to form the bridge of the nose; and they are also concave from above, downwards. Their posterior surfaces are each marked by a minute opening, for the transmission of small blood vessels and nerves. They are concave internally, to increase the cavities of the nos-

trils. Their figure is oblong, and is usually contracted in the middle, expanded above, and still more so below. Their upper edges, by which they are connected to the nasal process of the os frontis, are serrated, whilst the internal edges, where they are in contact, are flattened. Below, they terminate in a thin edge, by which they are articulated with the nasal cartilage, and their outer edges are rather serrated for connexion with the nasal processes of the superior maxillary bones. When they are in contact, there is a prominent ridge formed, by which they are articulated with the nasal lamella of the ethmoid bone, and thus they assist in the formation of the septum narium.

OSSA UNGUIS VEL OSSA LACHRYMALIA,

Are two small, flat, quadrangular-shaped bones, situated at the inner and fore part of each orbit, just beneath the internal angular process of the os frontis, and behind the nasal processes of the superior maxillary bones. The external surface of each bone is divided into two unequal por-

tions, by means of an oblique ridge, the outermost, or anterior of which is hollowed or grooved, to assist in the formation of the lachrymal fossæ, in which the lachrymal sac is received. The posterior, or innermost portion, is smooth, in order to form a part of the inner side of the orbit. The internal surface is concave, covering a part of the ethmoidal cells. Superiorly the bone has a rough and slightly serrated edge, by which it is connected with the internal angular process of the os frontis. Behind, it is opposed to the os planum of the ethmoid bone; in front it is connected with the nasal process of the superior maxillary bone; and inferiorly it joins the inferior spongy bone. It is this bone which is pierced in the operation for fistula lachrymalis, an operation which is easily performed, even with a common probe, care being taken to carry the point in the direction of the groove and nasal duct.

OSSA MAXILLARIA SUPERIORA.

The superior maxillary bones are two large bones of an exceedingly odd figure,

forming the greater part of the face ; being irregularly convex externally, and irregularly concave internally. From the upper and inner part of each bone, the nasal process ascends, terminating superiorly in a serrated edge, to be connected with the internal angular process of the os frontis. The external surface of this process is slightly grooved where it gives origin to the orbicularis palpebrarum and levator labii superioris alæque nasi muscles. The internal or nasal surface is somewhat concave, and presents a rough line, running from before, backwards, to which the inferior spongy bone is attached. Above this there is a depression, corresponding with the middle meatus ; and towards the top, a rough surface, which conceals the anterior ethmoidal cells. Behind, and to the outer side, there is another groove, very distinctly marked, which, when the bone is in contact with the os unguis, assists in the formation of the lachrymal sac. This groove is afterwards continued downwards, behind the nasal process, into the inferior chamber of the nose, and

forms a part of the nasal canal, through which the nasal duct passes. The anterior border of the nasal process is rough, for its articulation with the nasal bone. To the outer side, and more posteriorly than the nasal process, the orbital process is situated. This process slants upwards and backwards, and forms a large portion of the floor of the orbit. Underneath it, we find the *canalis sub-orbitarius*, which terminates anteriorly, at the *foramen infra-orbitarium*; an opening which is placed from a quarter to half an inch below the floor of the orbit. The canal and the opening transmit the infra-orbital blood-vessels and nerve. The space between the orbital and nasal processes is occupied by the *os unguis*. Below, and to the outer side of the orbital process, there is a rough eminence, which projects immediately over the second and third molar teeth; and has received the name of *malar tuberosity*, by which this bone is articulated with the malar. Underneath, and somewhat anterior to this eminence, the bone is hollowed, forming what is called the

fossa canina ; from which the levator anguli-oris muscle arises. Behind the malar tuberosity the surface is smooth, and slightly excavated, and forms a part of the zygomatic fossa. Beyond this the bone becomes convex and round, constituting the tuberosity, which has a number of small openings, transmitting the dental nerves. Inferiorly, the bone is lengthened by the alveolar border, which is semi-circular in shape, convex externally, and concave internally ; and its margin is pierced by a number of deep excavations, called acetabula dentia, into which the teeth are received. Upon the inferior part of the bone, internally, the palatine process is situated, which is hollowed above from side to side ; and inferiorly it passes in an arched direction, from before, upwards and backwards. It forms part of the roof of the mouth, and floor of the nostrils. On the inner side of this process there is a rough surface, where the bone meets with its fellow ; and anteriorly there is a small depression, which assists in forming the foramen incisivum. Upon this rough sur-

face, superiorly, there is a small kind of ridge or spinous edge, which, when articulated with the vomer, assists in forming the septum narium. At the termination of the alveolar edge, posteriorly, there is a small rough surface, which is connected with the tuberosity of the palate bone; and just above it there is a slight groove, which contributes to the formation of the posterior palatine canal. External to the palatine process there is a large cavity, which occupies nearly the whole of the body of the bone, and has been named from its describer, *antrum Highmorianum*. This cavity is concave towards the cheek, and flat towards the nose, and is separated from the nostril by a thin bony septum. In the macerated bone it appears a very large opening, but in the recent subject it is nearly wholly filled up with ligament; a very small aperture only, being left, just at the top of the cavity. This cavity, in persons who have carious teeth, is very frequently attacked with acute inflammation, accompanied with considerable febrile excitement; suppuration, indicated

by repeated rigors, follows ; and it becomes very soon distended with pus. The cheek appears puffed, shining, and livid, and the whole face enormously swollen and deformed ; the sufferings are at the same time exceedingly severe ; and if the pus be not speedily evacuated, caries of the bone takes place, and the matter makes its exit by ulcerating the integuments of the cheek, or sometimes by the sides of the molar or cuspidati teeth. In an acute attack, the diagnosis is generally clear, and these serious results may always be averted by a timely removal of the second and third molar teeth, and perforating the sockets with a probe or trocar. The pus then gradually drains away ; the patient experiences an instantaneous relief to his sufferings, and rapidly gets well. The author has himself, in several instances, merely used a probe, with the most successful results. Where the inflammation is chronic, it may go on a long time unobserved, the patient merely complaining of tooth-ache ; and the integuments of the cheek remaining free from discoloration or

swelling. The surgeon must therefore be on his guard, although in these cases the diagnosis is by no means difficult.

The superior maxillary bone is articulated with its fellow, with the frontal, ethmoid, os spongiosum inferius, os nasi, and os unguis, by its nasal process; with the palate bone, by its tuberosity; with the malar, by its malar protuberance; and, lastly, with the vomer and nasal cartilage, by the spinous ridge of its palatine process.

OS MALE.

This bone, which is quadrangular in form, is common to the face and orbit. Its anterior or facial surface, though pierced by numerous small foramina, is tolerably smooth and convex; whilst, posteriorly, it is a little concave. Its convexity forms the prominent part of the cheek, its concavity, a part of the temporal, or zygomatic fossa, under which the temporal muscle passes. The bone is distinguished, in addition, by three considerable processes, *viz.* an orbitar, maxillary, and a zygomatic. The orbitar process, placed su-

teriorly, forms a large portion of the lower and outer part of the orbit. It is bounded, anteriorly, by a raised lunated edge, which terminates externally and superiorly in a rough projection, by which it is connected with the external angular process of the os frontis. The maxillary process is situated upon the inner and lower part, and is articulated to the malar tuberosity of the superior maxillary bone. Behind, and most externally, we find the zygomatic process, which is connected with the same process of the os temporis, and thus the zygoma is formed. The anterior surface of this bone gives origin to the zygomatici; its inferior border to the masseter; and its anterior angle, partially to the levator labii superioris. It is articulated with the frontal and sphenoid bones, by its orbital process; with the superior maxillary bone, by its maxillary process; and with the temporal, by its zygomatic process.

OS PALATI.

The palate bone, though of an irregular shape, has not been inaptly compared to

the letter L, one part being vertical, and the other horizontal. It is wedged in, as it were, between the pterygoid process of the sphenoid bone and palatine process of the superior maxillary bone. It partly enters into the formation of the nose, mouth, and orbit, and may be divided into a nasal, pterygoid, and palatine portion; the nasal constituting the vertical, and the pterygoid and palatine the horizontal, portion, or, if the bone be viewed in profile, the base of the letter L. The palatine portion, or process, projects transversely inwards from the vertical, and has, anteriorly, a rough surface, by which it is connected to the back part of the palatine process of the superior maxillary bone. It has also another rough surface, upon its inner side, connecting it with its fellow. This lateral rough edge has, superiorly, a projecting spinous ridge, corresponding with that of the palate plate of the superior maxillary bone; and when these bones meet with their fellows, there is a fissure formed between their spinous ridges, into which the vomer is received.

The palatine process is concave, both superiorly and inferiorly, forming a part of the floor of the nostrils and roof of the mouth. The superior concavity is bounded externally by a ridge, to which the inferior spongy bone is attached; and this forms the boundary of the inferior meatus, and line of demarcation between the palatine and nasal portions. The inferior concavity of the palatine process has, upon its outer side, an oval opening, which is called the foramen palatinum posterius. It is the inferior termination of the posterior palatine canal; and if the base of the skull be referred to, the student will have a better idea of its real situation; for it is placed between the outer side of the palatine process of the palate bone, and the inner side of the alveolar margin of the superior maxillary bone, just anterior to the point of junction between these bones and the pterygoid processes of the sphenoid bone. It transmits the descending palatine blood-vessels and nerves. Behind this opening there is usually another, much smaller, in the palate bone itself. Pro-

ceeding backwards and outwards from the palatine process, we find the pterygoid process, having, posteriorly, two indistinct rough grooves, separated by a spinous ridge, by which it is articulated with the anterior part of the pterygoid process of the sphenoid bone. The outer part of *this*, the pterygoid portion of the palate bone, has a rough but slight projection, which has received the name of tuberosity, by which it is connected with the inner part of the tuberosity of the superior maxillary bone. Ascending from the outer side of the palatine process we find the nasal or vertical process, projecting perpendicularly upwards, and diverging at the summit into two processes. It is situated just upon the inner side of the tuberosity of the superior maxillary bone, and commences at the ridge upon the outer side of the palatine process, to which the inferior spongy bone is attached. That part of the bone above the ridge is a little convex, and forms the outer wall of the middle meatus, whilst the outer side is concave, where it closes

a part of the antrum of Highmore. This side is unequally divided by a perpendicular groove, which, when the bone is in contact with the superior maxillary, forms the posterior palatine canal; terminating inferiorly, as we have before stated, at the foramen palatinum posterius. Of the two processes formed by the divergence of the nasal portion, superiorly, the anterior inclined outwards and forwards, forms a small portion of the floor of the orbit. Internally it is hollowed, and closes a part of the ethmoidal cells. The posterior, much lower than the anterior, consists of a thin plate of bone, which, internally, forms a part of the nasal fossæ; and, externally, looks towards the azygos process of the sphenoid bone. At the point of divergence, there is a small excavation, which forms, with the sphenoid, the sphenopalatine foramen, transmitting the sphenopalatine artery and nerve, a branch of the second division of the fifth pair of nerves.

The palate bone is articulated with its fellow; also with the superior maxillary, ethmoid, sphenoid, vomer, and inferior spongy bones.

OSSA SPONGIOSA INFERIORA.

Each bone is of a spongy structure, hence its name, extending from before, backwards, along the side of the nasal fossæ. It is curled up in the nostril, being attached to the inner side of the nasal processes of the superior maxillary and palate bones, and also to the os unguis, here closing a considerable portion of the opening from the antrum. Above, and upon the inner side, where it is opposed to the septum narium, it is regularly convex, whilst the outer part is considerably hollowed. Inferiorly, the bone is turbinated or twisted, and on this account it is often called *turbinated bone*, from its supposed resemblance to the lateral half of an elongated bivalve shell.

This completes the description of the six pairs. We shall now commence that of the vomer and os maxillare inferius.

VOMER,

So named from its resemblance to a plough-share, is situated vertically, be-

tween the nasal fossæ. It possesses two surfaces (one on each side) and four edges. The lateral surfaces form part of the septum, dividing the nasal fossæ. The superior edge is thick, and deeply grooved, and into this groove the processus azygos of the sphenoid bone is received. The anterior edge, consisting of two portions, is also grooved : the superior, to be articulated with the nasal lamella of the ethmoid bone ; and the descending, or inferior, which is grooved likewise, to be connected with the middle nasal cartilage. The inferior edge is merely a thin plate, which is received between the spinous ridges of the palatine processes of the superior maxillary and palate bones ; whilst the posterior, turned towards the cavity of the fauces, is thin and unconnected with any other bone.

OS MAXILLARE INFERIUS.

This bone has been compared in figure to a horse-shoe, but more correctly to the Greek *υ* *upsilon*. In the fœtus it is divided into two portions, which are after-

wards consolidated in the centre, forming a prominence, which has been called the symphysis, or chin. Proceeding outwards and backwards, upon each side is seen the base, and this terminates at the angles. Superiorly the bone is deepened by the alveolar border, which is horizontal, and is pierced by the acetabula dentia, corresponding with those of the superior maxillary bone. About an inch to the outer side of the symphysis, on each side of the bone, the foramen mentale is situated, which is the anterior termination of the inferior maxillary canal, and transmits the terminal branches of the dental nerve and artery. Passing upwards and obliquely backwards from the angles, we find the ascending plates; each plate terminating superiorly, in two considerable processes, the anterior of which, nearly vertical, and called the coronoid, is thinner, than the posterior, and has a pointed or conical extremity, which receives the insertion of the temporal muscle. The posterior, oblique, much stronger than the anterior, terminates by an oblong process, called

condyloid, having its greatest diameter from without, inwards, and is covered with an articulating surface, which is received into the glenoid cavity of the os temporis. Between these two processes the bone is deeply excavated, forming what is called the sigmoid notch; and if viewed when the bones are in situ, it will be found to form a complete circle, with the arch of the zygoma. If the coronoid process be carefully examined, it will be seen to arise by two prominent oblique lines; one on each side, which pass obliquely downwards and forwards, that on the outer side terminating in the base of the jaw, opposite to about the first molar tooth. Its union with the base renders the anterior part of the latter very projectile; and above it the bone recedes somewhat, constituting the incisor fossa. The line upon the inner side may be traced, descending as far forwards as the tubercle of the jaw, a prominence we shall presently speak of. Both of these lines give origin to muscles: that on the inner side more particularly to the mylo-hyoideus. Above this, there is a

smooth surface, with which the sub-lingual gland lies in contact; and below it an oblong depression, which receives the sub-maxillary gland. Upon the inner side of the ascending plate there is a large opening, which is called the foramen maxillare posterius, or the posterior opening of the inferior maxillary canal, transmitting the inferior maxillary blood-vessels and nerve. This opening leads into a canal which runs throughout the whole extent of the bone, and terminates near the symphysis, anteriorly, at the foramen mentale. Immediately below the opening there is a groove, which marks the passage of the vessels previously to their entering the canal. The angles of the bone internally are rough, receiving the insertion of the pterygoideus internus. The outer part of each angle is also rough, receiving the insertion of the masseter muscle. Opposite to the symphysis, internally, there is a small tubercle, (before alluded to,) which gives origin to the genio-hyoideus and genio-hyoglossus muscles. Beneath this there are two depressions, which receive

the insertions of the digastric muscles. This bone is articulated by means of its condyles and inter-articular cartilages, with the glenoid cavities of the temporal bones. It is a diarthrodial articulation and its motions are upwards and downwards ; but in consequence of the articulating surfaces of the glenoid cavities extending upon the roots of the zygomatic processes, a considerable degree of lateral or grinding motion is also permitted, and it may likewise be carried beyond the upper jaw.

THE TEETH.

The teeth, in the adult, are thirty-two in number ; sixteen being implanted into each jaw. Each tooth is divided into three parts, *viz.* a *root*, which is concealed in the alveolus, or socket ; a *crown*, or head, projecting above the level of the alveolar margin ; and an intermediate part, or *neck*, connecting the two former. The root and neck are composed of a peculiarly dense osseous matter, similar in hardness to the *pars petrosa* of the temporal bone ; whilst the crown is encased by a layer of white

and excessively hard substance called enamel. This is very abundant at the superior part of the tooth; but less so, at the neck, and disappears at the very commencement of the root. Each tooth is also hollow in the centre, and is here lined with a very delicate membrane, upon which the nutritious vessels of the tooth ramify. This cavity however becomes obliterated in old age.

The teeth are divided into four classes, *viz.* the *incisors*, *cuspidati*, or *canini*, *bicuspidati*, or small molares, and the *large molares*.

The *incisors*, four in number in each jaw, situated at the fore-part of the mouth, are all of them somewhat cuneiform or wedged shape, being thin superiorly, convex anteriorly, flat behind, and compressed upon the sides. Those of the upper jaw are larger than those of the lower; their roots are single, elongated, and conical.

The *canini*, or *cuspidati*, two in each jaw, are situated upon the outer side of the incisors. They are convex anteriorly, and concave behind; and superiorly terminate

in an obtuse edge. Their roots are single and conical, and are longer than those of any other teeth.

The *bicuspidati*, four in each jaw, so called from their having two roots, are situated between the *canini* and molar teeth; and are intermediate to them in size. They are convex both before and behind, and compressed laterally. Their cutting extremities terminate in two tubercles, one external, the other internal; the former being the larger. Their root is single, except at the point, where it is slightly bifid.

The *molares*, six in number in each jaw, complete the set. They are of a cuboid figure at the crown, compressed on the sides, as well as from before, backwards; and terminate superiorly in four considerable tubercles; two situated externally, and two internally, are separated from each other by a crucial depression, which better fits them for the purposes of trituration. Their roots are divided into three or four processes: sometimes however there are but two. The last of this set are the smallest,

and are usually called *dentes sapientiæ*, from their not appearing till an advanced period of life.

THE ORBITS.

The orbits are two large funnel-shaped cavities, situated just beneath the os frontis, having their bases turned forwards and outwards, and their apices backwards and inwards. Each orbit is composed of seven bones, three of which are cranial, and are common to both orbits, *viz.* the frontal, ethmoid, and sphenoid bones; and four of the face, which are proper to each orbit, *viz.* the superior maxillary, malar, palate, and os unguis; so that entering into the formation of both orbits there are only eleven bones.

The upper part or roof of each orbit is concave, and is formed by the os frontis; the lower part by the os maxillare superius. The inner portion partly by the os unguis and os planum of the ethmoid bone; the outer part by the os male and os sphenoides; and the back part, in part by the os planum of the ethmoid, and by

the os palati. The os frontis forms the largest, and the os palati the least part of each orbit.

Openings into the Orbits.

In the inner side of each orbit the foramina orbitaria interna anteriora et posteriora are situated; at the back part the foramina optica; and to the outer side of these, the foramina lacera orbitalia superiora. At the lower and outer part, the fissura spheno-maxillaris, so called from its being placed between the sphenoid and superior maxillary bones. Underneath the centre of each orbit the canalis sub-orbitarius is situated, which terminates anteriorly at the foramen infra-orbitarium. In the upper margin we find the foramen supra-orbitarium, and to the inner side of this a groove, which transmits the tendon of the superior oblique muscle of the eye. The external margin of the orbit retreats considerably behind the internal, for the purpose of allowing a free range of lateral vision.

Situation of the Palato-Maxillary Canal.

This canal is to be found at the posterior termination of the speno-maxillary fissure, in the space between the pterygoid process of the sphenoid bone, and tuberosity of the superior maxillary bone. If a probe could be passed perpendicularly through the foramen rotundum, at the base of the skull, it would be sure to track the course of this canal, which terminates inferiorly, at the foramen palatinum posterius, and transmits the palato-maxillary blood-vessels and nerve.

The Nasal Fossæ.

The nose is formed partly of bone and partly of cartilage, and is divided in the median line into two cavities or fossæ, by means of the septum narium. These fossæ communicate by foramina with the sinuses of the frontal, ethmoid, sphenoid, and superior maxillary bones. Anteriorly, they open on the surface by means of the nares, and posteriorly, into the pharynx.

The septum narium is formed by the vomer, nasal lamella of the ethmoid bone, assisted by the spines of the ossa nasi, palate and superior maxillary bones, and also by the processus azygos of the sphenoid.

The nose is completed anteriorly, by five cartilages. The first is articulated with the anterior border of the vomer; two others form the apex, being attached to the ossa nasi; and the sides are completed by the alæ nasi.

The floor of the nasal fossæ, smooth and concave from side to side, is formed by the palatine processes of the superior maxillary and palate bones. The roof, which is arched anteriorly, by the ossa nasi, nasal processes of the os frontis and superior maxillary bones; and posteriorly, by the sphenoid and cribriform lamella of the ethmoid bone. The parietes also by the ossa nasi, and nasal processes of the superior maxillary bones, and by the os unguis and os planum of the ethmoid, on each side. In the cavities of the nasal fossæ the spongy bones are pendant, dividing each fossa into three distinct chambers, *viz.* a supe-

rior, middle, and inferior. The superior chamber, or superior meatus, is situated between the superior ethmoidal spongy bone and the second ; the middle, between the second and the inferior spongy bone ; and the inferior, between the inferior spongy bone and roof of the mouth. Into each superior chamber there is an opening from the sphenoidal sinuses, and from the posterior ethmoidal cells ; also from the sphenopalatine foramen ; and partly from the frontal sinuses. Into the middle chamber there is an opening from the antrum, and likewise from the frontal sinuses. The anterior ethmoidal cells, communicating with the frontal, may be equally said to open into this chamber. Into the inferior chamber there is an opening from the nasal duct, and also another on the fore-part, from the foramen incisivum, or foramen palatinum anterius, as it is often termed. The nose is lined in all its cavities by a very delicate secreting membrane, called the *membrana pituitaria*. It extends into the different sinuses and cells of the frontal, sphenoid, and ethmoid bones. It secretes the mucus of the nose, and upon

it the filaments of the first pair of nerves, conveying the sense of smell are expanded.

OS HYOIDES.

So named from its resemblance to the Greek *v*, *upsilon*, is situated at the base of the tongue, immediately above the thyroid cartilage. It consists of a body, two cornua, and two cornicula. Anteriorly, the body is convex, having in the centre a vertical line, on each side of which are depressions for the attachment of muscles. Posteriorly it is concave, and corresponds with the epiglottis. The cornua project backwards, and end in a rounded point. The cornicula, short and irregularly conical, are placed at the junction of the body with the cornua, and give attachment to the stylo-hyoidean ligament. They remain for many years moveable, the cartilage connecting them seldom becoming ossified till a very advanced period of life.

Having completed the description of the head, we now pass on to that of the second division of the skeleton, the *trunk*, which forms the subject of the third section.

SECTION III.

BONES OF THE TRUNK.

The trunk is divided into three parts, *viz.* the *Spine*, *Thorax*, and *Pelvis*.

The *spine*, or vertebral column, is composed of a number of bones, which are termed *vertebræ*, from their mobility (*verto* to turn). Of these, twenty-four are moveable, and are called *true* *vertebræ*, whilst the remainder, nine in number, become consolidated, as life advances, and form but two bones, *viz.* the sacrum, composed of five portions, and the os coccygis of four, which have consequently received the name of *false* *vertebræ*.

These bones are so arranged as to constitute two pyramids, which are approximated at their bases. The upper pyramid is the longest, and is made up of the twenty-four moveable, or *true* vertebræ. The lower pyramid, on the contrary, is the widest, and if straight, would more strictly deserve the name. It consists only of the sacrum and coccyx, which will be described along with the bones of the pelvis.

A lateral examination of the spine, in the perpendicular direction, will present several alternate advances and recessions, in its course; from above downwards, which serve very important purposes. Commencing at the atlas, or first bone of the vertebral column, it will be found to advance throughout the greater part of the neck, till it reaches the top of the back, for the purpose of affording support to the trachæa æsophagus and great vessels of the head and neck. Tracing its course downwards, it may be observed to recede throughout the greater part of the back, in order to increase the space for the thoracic viscera. At the lower part of the back it again advances, and con-

tinues to do so throughout the greater part of the loins, to give support to the abdominal viscera. From the lower part of the loins, it a second time recedes, till it reaches the sacrum, for the purpose of allowing the weight of the body to fall perpendicularly upon the base of the sacrum. The sacrum itself is concave, to increase the size of the pelvic cavity, and the room for its contents; and lastly, the lower extremity of this bone, uniting with the os coccygis, curves forwards to support the extremity of the rectum.

The *true* vertebræ are divided into three classes, which are named according to the regions which they occupy; thus the seven superior are called *cervical*, the twelve next *dorsal*, and the five inferior the *lumbar*, making the upper pyramid as has been stated to consist of twenty four bones. These three classes are similar in their general characteristics, but differ very essentially in certain peculiarities, although as the different classes approach each other, the lower portions of the superior class become nearly identical with those of the class immediately below them.

General characteristics of the Vertebræ.

Upon taking up a vertebra of any class it is found to possess a *body*, an *arch*, seven *processes*, and a *foramen* in the centre, lodging or transmitting the medulla spinalis. Each vertebra has also a *notch* or excavation upon the upper part of the arch, and a similar *notch* inferiorly; and when the different vertebræ are approximated to each other, these *notches* are formed into complete and nearly circular *apertures*; which have received the name of *inter-vertebral foramina*, and give transmission to the spinal nerves. Of the seven *processes*, there are two superior and two inferior *articular*, so called from their articulating with corresponding processes of an adjoining vertebra; also two others which from their direction, are termed *transverse*; and, lastly, the *spinous*, situated posteriorly.

*Particular description of the Cervical
Vertebræ.*

The bodies of the cervical vertebræ are smaller and of a closer and firmer struc-

ture than those either of the dorsal or lumbar. They are hollowed above from side to side, and below, from before, backwards. The articular processes, both the superior and inferior, are situated obliquely, whilst those of the dorsal and lumbar are placed perpendicularly; the superior face obliquely upwards and backwards, the inferior downwards and forwards; being just the reverse of the superior. The transverse processes pass outwards, and are short, and generally bifid at their extremities, giving attachment to muscles: each possesses a foramen which transmits the vertebral artery; and they are also marked by grooves superiorly, which give passage to the spinal nerves. Projecting horizontally backwards from the arch, is the spinous process, which, like the transverse, is bifid at its extremity, giving attachment to muscles. It does not lock down upon that of the vertebra beneath it, as do those of the dorsal or second class. The foramen for the transmission of the spinal marrow, is situated between the arch and the back part of the body of the vertebra, and is of a triangular form.

To this general description of the *cervical* vertebræ there are some exceptions. These exceptions are to be found in the *first*, the *second*, and the *seventh*.

The *first* or *atlas*, so called from its supporting the head, is a mere imperfect bony ring, having nothing analagous either to body or spinous process. In the place of the latter there is a small projecting *tubercle*, and there is also an expansion of the ring on each side, where the articular processes are situated. Upon the fore-part of the ring, externally, a *tubercle* may be observed; and internally, a smooth depression, lined with an articulating surface, for connexion with the dentiform process of the second vertebra. The articular processes are situated horizontally; the superior are hollowed and nearly face each other, and thus they are well adapted to receive the convex condyloid processes of the os occipitis; the inferior are somewhat flattened, in order that the atlas may roll upon the dentata. Upon the inner side of the superior articulating processes there are two small *prominences*, called *tubercles*, to which

the *transverse* ligament is attached, which crosses behind the processus dentatus, and confines it in its situation, and at the same time, divides the foramen of the atlas into two *parts*; the *anterior* being occupied by the processus dentatus, and the *posterior* by the commencement of the spinal marrow. It is this ligament which defends the spinal marrow from injury, and whenever from accident or disease it gives way, the head falls forwards, the spinal chord is compressed, and instantaneous death is the immediate result. The transverse processes are remarkably strong, and are not bifid at their extremities, although they give attachment to some of the small oblique muscles of the head. Behind the superior articular processes there is a *groove*, winding in a horizontal direction; it transmits the vertebral artery, after it has traversed the foramina of the transverse processes, which here makes a wide and sudden turn to get into the skull.

The *second* vertebra, or *axis*, so called from its forming the *pivot* upon which the head rotates, is somewhat triangular in form.

It is likewise termed *dentata*, from its tooth-like process. This process, which is its most distinguishing characteristic, ascends perpendicularly, to be received into a small articulating cavity upon the fore-part of the ring of the atlas, internally; and has, anteriorly, a *smooth surface*, corresponding to that upon the atlas. Its termination, superiorly, is *conical*, and altogether it is about as thick as the little finger. Inferiorly, near its root, it is somewhat contracted, and has upon its back part, in some subjects more distinct than in others, a *groove*, which is occupied by the transverse ligament. Superiorly it gives attachment to the perpendicular ligament, which passes to be inserted into the basilar process of the occipital bone. The superior articular processes are nearly *flattened*, in order that the inferior articular processes of the atlas may roll upon them, as the fore-part of a waggon does upon the fore-carriage, only in the inverted direction; so that the atlas being threaded, as it were, by the *dentiform* process, rests upon the shoulders of the *dentata*, and there turns

and performs all the rotatory motions of the head. The transverse processes, compared with those of the atlas, are exceedingly *short*; and are not bifid at their terminations. The spinous process is *short, thick, and diverging*; the two portions are somewhat inclined downwards, so as not to interfere in any degree with the rotation of the atlas. The foramen for the transmission of the spinal marrow approaches nearer to the *circular* than the triangular form. The last exception to the *cervical* vertebræ is the *seventh*.

The *seventh* cervical a good deal resembles the first dorsal, and particularly in the *length* of its spinous process, which is not bifid, but terminates in a *tubercle* or *point*. The transverse processes are not bifid; and the foramen in them is very *small*, merely transmitting a vein from the spinal marrow and not the vertebral artery.

Dorsal Vertebræ, or Second Class.

The dorsal vertebræ are larger than the cervical, and on examination it will be found that the *structure* of their bodies is

more *spongy*, notwithstanding they are surrounded by a firm case of bone externally. They are rounded or convex anteriorly, and slightly excavated posteriorly; they are also flat above and below. On each side of the body posteriorly, and at the upper part we may observe *half* an articulating surface, and a similar *half* of one below, for connexion with the heads of the ribs. The articular processes are placed *perpendicularly*; thus differing from the cervical or first class, in which we find them oblique. The two superior face backwards, whilst the two inferior face forwards. The transverse processes are remarkably *strong*, and project obliquely outwards and backwards. Upon the extremity of each process there is a small *articulating* surface; in the upper dorsal vertebra, *concave*; in the lower *flat*, for articulation with the tubercles of the ribs. The spinous processes, arising by a triangular base, pass *obliquely* downwards and backwards, and terminate in a *tubercle* or *point*. Upon the upper part of each there is a small *ridge*, or sharp edge, and, inferiorly, a corresponding *excavation*

or depression; and when the spine is extended, this excavation inferiorly receives the ridge of the same process below it; and thus all lateral motion is completely prevented by these processes locking down, as it were, upon one another. The *arches* are *broad* and *thick*; and the foramen for the transmission of the spinal marrow, in all the dorsal vertebræ, is nearly *circular*. The lateral notches, and consequently the inter-vertebral foramina which they form, are *larger* than those of the cervical.

The exceptions to this general description of the second class are, the *first*, the *tenth*, *eleventh*, and *twelfth*.

Upon the *first* dorsal there is a *whole* articulating surface, at the upper part, for connexion with the whole of the head of the first rib; below there is *half* an articulating surface for half the head of the second rib. The articular processes are *oblique*, and the spinous is more *horizontal* than any of the rest.

Upon the *tenth* there is an articulating surface, at the upper part, which receives the *whole* of the head of the corresponding rib, but *no* articulating surface inferiorly.

Upon the *eleventh* and *twelfth* dorsal vertebræ there are *whole* articulating surfaces, receiving the heads of their corresponding ribs. There are *no* articulating surfaces, however, upon their transverse processes, because the two last ribs have no tubercles, and consequently the connexion between them and these vertebræ is only with their bodies, and not with their transverse processes. The *general conformation* too of these bones very much approaches that of the lumbar vertebræ.

Lumbar Vertebræ, or Third Class.

The bodies of the lumbar vertebræ completely resemble the dorsal, excepting that they are *larger*, and are more *spongy* in their internal structure, although surrounded by a firm osseous case externally. They are much *rounded* anteriorly, but posteriorly they are nearly *flat*; they are also *flat* above and below. The superior articulating processes, are, like the dorsal, placed perpendicularly, and are hollowed, and face each other, whilst the transverse processes pass nearly *horizontally* outwards from the arch,

and are *long* and *slender*, giving attachment to the abdominal muscles. The spinous processes in the two first lumbar pass *downwards* and *backwards*, and terminate in a *perpendicular obtuse edge*. The foramen for the transmission of the spinal marrow is nearly *triangular* in the upper lumbar, and completely so in the lower ; and transmits, in the latter, the extreme portion of the spinal marrow, which here splits into numerous fibrillæ, and forms what is called the cauda equina.

Inter-vertebral Substance.

The inter-vertebral substance is, as its name implies, situated between the bodies of the vertebræ. It is commonly termed a *ligamento-cartilaginous* structure, though improperly, for it is neither ligament or cartilage, but may be said to be *intermediate* to both. Anteriorly, it appears to consist of concentric *lamellæ*, which adhere very firmly to the face of each vertebra ; and in addition it is attached very strongly to each by ligamentous matter. Internally, and in the centre, it is nearly *semifluid* ; and is

consequently *there* but very little compressible. It increases in quantity as the vertebræ descend, although it is ~~not~~ strictly proportioned to their size, being more abundant between the bodies of the cervical, in proportion to *their* size, than between those of the lumbar. It possesses so much *elasticity* externally, that if the body be bent to one side, it immediately yields; but the moment the position is changed, it returns by a powerful resiliation to its original dimensions. By its firm connexion with the different vertebræ, the motions of the spine are rendered more secure; and it is one of the wisest provisions in the structure of the human frame, for by its extremely *elastic* qualities, all shocks in leaping or from falls, which, without it, would in all probability prove fatal, are effectually prevented from injuring the spinal marrow, or producing luxation of the vertebral joints.

The *articulations* of the spine may be referred to two, out of the principal classes under which the various joints are arranged, *viz.* to *Diarthrosis* and *Amphi-artrosis*.

Those of the *former* existing between the atlas and occiput, between the articulating processes of the vertebræ themselves, and also between the transverse processes and the ribs ; whilst those of the *latter* are only to be found between the bodies of the vertebræ. The *articulation* however, between the fore-part of the ring of the atlas and the processus dentatus of the axis, is a specimen of the second subdivision of the *lateral or rotatory ginglymus*, which has received the distinguishing appellation of *single*, (*vide* page 18.) in contra-distinction to that of *double*, from the movement being performed at a single point.

Motions of the Spine.

In consequence of the immense number of joints between the different portions of the spine and intervention of the inter-vertebral substance, the vertebral column constitutes the common centre of the movements of the body ; and, taken as a whole, the motions of which it is susceptible are very considerable. The degrees of motion however, vary with the forms of the differ-

ent vertebræ in each division of the spine ; thus we find it most extensive in the neck, more limited in the loins, whilst in the dorsal portion scarcely any at all exists.

All the nodding movements of the head are performed by the condyloid processes of the occipital bone moving upon the superior articular processes of the atlas.

The rotatory motion is effected by the first vertebra rolling upon the shoulders of the dentata. All the lower vertebræ of the neck allow of flexion and extension, and of a slight degree of lateral motion ; and by their combined assistance the nodding and rotatory movements of the head are much increased. In the dorsal portion of the spine merely flexion and extension are permitted, whilst in the lumbar portion, in addition to these two kinds of movements, slight lateral motion is also allowed ; so that there may be a general twisting and bending of the whole spine. When the body is bent forwards, the weight falls upon the anterior part of the bodies of the vertebræ, but when extended backwards, it is principally thrown upon the back part of the bodies, and also

upon the articulating processes ; when it is bent laterally, it is partly thrown upon the one, and partly upon the other.

The spine supports the head, neck, and upper extremities ; in connexion with the ribs, it forms the thorax ; and it likewise furnishes a bony canal in the centre, protecting the spinal marrow from compression or injury.

BONES OF THE THORAX.

The *thorax* is composed of thirty-seven bones, *viz. twelve dorsal vertebræ*, already described, which are common to it, and to other parts ; *twenty-four ribs* ; and a *sternum* anteriorly, which are proper and peculiar to it.

DESCRIPTION OF THE RIBS.

The *ribs*, twelve in number on each side, form a number of arches, extending laterally from the sternum to the spine. They are divided into two classes, which are very properly termed *true* and *false*. The seven superior on each side are united by cartilage to the sternum, thus completely en-

circling the thorax; and on this account are designated *true* ribs, whilst the five inferior are merely connected to each other by cartilage, and have therefore received the name of *false* ribs. The two last of these have no mutual connexion whatever, but project out from the spine separately and detached; the cartilage with which their anterior extremities are tipped, having merely a slight inclination upwards; hence they are termed *loose* or *floating ribs*; and in the recent subject they are found imbedded, as it were, amongst the abdominal muscles, to which they afford strong points of attachment. The breadth, length, and course of the ribs present some varieties. Thus we find that in length they increase from the first to the seventh, and decrease from the seventh to the last. Their breadth, on the contrary, diminishes from the first, downwards. Their position is at first nearly horizontal, particularly that of the first rib, so as almost to form a right angle with the vertebral column; but as they descend, they take a more oblique course, and in proportion to this obliquity down-

wards, their under edges become everted. If the student examines them in the articulated skeleton, he will find that the cartilages exactly correspond to the length of the ribs, and as the latter descend, so the former ascend, to be connected to the sternum and to each other, with the exception of the first, which is nearly straight.

Externally the ribs are convex, a disposition which adds very materially to their strength, and better enables them to resist the pressure of the atmosphere; whilst internally they are concave, thus increasing the room for the thoracic viscera. That part of the rib which is in connexion with the spine is called the head; upon it we find two small articulating surfaces separated, or rather divided from each other, by an oblique ridge. These surfaces correspond to those found upon the upper and lower part of each dorsal vertebra; and the ridge separating them is received between the junction of two vertebræ. About an inch to the outer side of the head there is a tubercle, and upon this tubercle an articulating surface for connexion with the transverse process

of each dorsal vertebra. That part of the rib between the head and the tubercle is somewhat contracted, and hence it has been called the *cervix costæ*. Beyond the first tubercle there is a prominence, which, though small, has been described as constituting a second tubercle; it gives attachment to a ligament, tying the rib to the back part of the transverse process of a vertebra. Someway beyond the second tubercle there is a rough line, marking what is called the angle of the rib. Now the angle is formed by the rib as it passes from the spine, taking a sudden curve forwards; and is situated between the tubercle and the remaining portion of the bone, which is most convex, and which has been called its body. The distance of the angle from the tuberosity increases gradually from the first to the eleventh inclusive. In the last it is not perceptible, and in the first it is not distinguishable from the tuberosity. Upon the anterior extremity of the body there is an imperfect rough socket, into which the cartilage connecting the rib to the sternum is received. The upper surface of the body is

rounded and convex, whilst the under surface, on the contrary, has a sharp edge, which conceals upon its inner side a large and deep groove, termed intercostal, from its lodging the intercostal artery and vein. This groove is most distinct near the spine.

To this general description of the ribs there are, as in the vertebræ, certain exceptions. These exceptions are to be found in the *first*, the *eleventh*, and the *twelfth*.

The *first* rib is remarkable for its thickness and strength ; for its almost horizontal position, and for its circular shape, forming, in conjunction with its cartilage, more than half of an imperfect circle. It has no angle, and is not characterized by that contorted appearance which the remainder of these bones have, more or less, in common. Upon its head there is an articulating surface without any oblique ridge ; and upon its flat upper surface there are two large grooves ; sometimes, however, scarcely distinguishable, transmitting the subclavian artery and vein, just before the former vessel takes the name of axillary artery : the groove for the

artery, which is always the deepest, is placed nearest the shoulder. Its external border, or rather, what in any other rib is called the inferior edge, is rounded and convex, whilst its internal is thin, and forms the margin of the superior aperture of the chest. The last peculiarity of this bone is, its having no intercostal groove upon its under surface.

Upon the *eleventh* and *twelfth* ribs there are whole articulating surfaces corresponding to those upon the two last dorsal vertebræ, but they have no tubercles. The intercostal groove upon the *former* rib is nearly indistinct; in the *latter* it is entirely so.

The *cartilages* of the ribs, also twelve in number, complete the shape of the thorax, and constitute all the lunated edge of that cavity; and it is from this cartilaginous circle that the greater muscle of the diaphragm has its chief origin; forming the partition between the thorax and abdomen. *They* are connected to the anterior extremities of the ribs by imperfect joints, which are liable to luxation from falls or blows. *They* are implanted into the sternum by round sockets, which may be distinguished as we shall

presently see upon each side of that bone. The *cartilages* of the first and second ribs rather descend to touch the sternum ; *that* of the third rib is direct. *Those* of the fourth, fifth, sixth, and seventh ribs, rise upwards in proportion to their distance from this central one. The first five ribs have independent *cartilages* ; the eighth, ninth, and tenth ribs run their *cartilages* into the *cartilage* of the seventh rib. The eleventh and twelfth ribs have their *cartilages* small and inclined upwards, but unconnected, loose, and floating. Like the ribs they diminish in breadth from the first to the last.

Motions of the Ribs.

The extent of motion increases as the ribs descend ; thus the first rib is the most fixed, whilst the last true rib (the seventh) moves extensively. In inspiration the ribs ascend, and their under edges are thrown outwards, and thus the cavity of the thorax is very considerably enlarged. In expiration they return to their original situation.

THE STERNUM.

The *Sternum* completes the osseous cavity of the thorax, anteriorly, and is situated exactly in the median line of the body. It is of a spongy structure and elongated form, being broad superiorly, contracted in the middle, and inferiorly terminating in a point. Its anterior surface gives attachment to the aponeurosis of the pectoralis major, and sterno-mastoid muscles; and is marked by four transverse lines, indicating its original division into five pieces, and even in old age it is fairly divisible into *three*; but the third portion, which is termed the *cartilago ensiformis vel iaphoides*, from its supposed resemblance to a sword's point, only becomes ossified in old age. This bone is placed in an arched direction from above, downwards, being slightly convex upon the fore-part, and slightly concave posteriorly, and thus it corresponds to the shape of the ribs.

The *first* portion is cordiform in figure. Upon the upper and back part of it there is a notch or excavation, transmitting the trachæa as it enters the chest. On each

side of this notch we find an articulating surface, receiving the sternal extremities of the clavicles; but the extremities of the clavicles and the sternum are not actually in contact, being separated by an inter-articular cartilage, which forms the connecting medium. Below these surfaces for the clavicles, there is a depression upon each side, receiving the cartilage of the first rib; and a half of one immediately beneath it, receiving half the cartilage of the second rib. Inferiorly, there is a rough surface, connecting it to the upper part of the second portion.

The *second* portion is about four or five inches in length. It has a rough surface superiorly, connecting it to the under part of the first portion; also at its lower part there is another surface, by which it joins the *cartilago ensiformis*. Upon each side there are depressions or notches, receiving half the cartilage of the second rib, the whole of the third, fourth, fifth, sixth, and half that of the seventh rib. The five inferior notches approach nearer to one another in proportion as they are situated lower down.

The *third* portion, or *cartilago ensiformis*, is about an inch and a half in length, and is rather of a triangular shape; sometimes its extremity is bifid, and in different individuals projects very much, so as to be frequently visible, on exposing the body. Inferiorly there is a rough surface connecting it to the under part of the second portion, and upon each side there is a small excavation, receiving half the cartilage of the seventh rib.

The motions of the sternum are entirely influenced by those of the ribs. In inspiration it advances, and in expiration it returns to its former situation.

BONES OF THE PELVIS.

The pelvis is a large osseous cavity, which has not been inaptly compared to a basin. Its form is somewhat circular, and its size subject to variety; both which are dependant upon age and individual conformation. In the adult it is composed of four bones, two of which are of enormous magnitude, not only constituting two thirds of its circumference, but also forming its wings, which

project, as we shall presently find, considerably above what is termed the brim of the pelvis. These two bones are called, from their irregular figure, *ossa innominata*. The remaining or posterior third of the pelvis, is completed by the lower pyramid of the vertebral column, composed as we have before described, when speaking of the spine, of two bones, the *sacrum* and *os coccygis*.

In the fœtus, and even in childhood, the pelvis may be said to have no less than fifteen bones entering into its formation, though in after-life by the process of ossification this number is reduced to four. This is explained by the *ossa innominata*, consisting of three portions each; the *sacrum* of five; and the *os coccygis* of four. In the adult, however, these separations no longer exist, although the marks of their original division generally remain more or less distinct.

Ossa Innominata.

In describing the *os innominatum* of either side, it is not only convenient, but ne-

cessary to consider separately each of the parts into which it is found divided in early life, both on account of its facilitating the acquirement of its anatomical characters, and of our retaining technically those divisions even in old age.

Each bone then is divided into the *ileum*, situated superiorly; the *ischium*, inferiorly and posteriorly; and the *os pubis*, anteriorly.

The Ileum.

This portion forms the upper and larger part of the haunch bone, and wing of the pelvis. Superiorly, the crista is situated; this forms an epiphysis in infancy; and is also termed the spine of the ileum. It passes in an arched direction, from before, backwards, and consists of two labia, to which the abdominal muscles are attached. It is bounded both anteriorly and posteriorly by two processes, *viz.* the anterior, superior, and posterior, superior, spinous processes; to the anterior superior the tensor vaginæ femoris and sartorius muscles are attached, and also the iliac extremity of Poupert's ligament. About an inch and a half below

this process there is a similar one, which, from its situation, has been termed the anterior and inferior spinous process, and to it the short head of the rectus femoris is attached. At the posterior termination of the spine we shall find, as we have just mentioned, the posterior, superior, spinous process, and also the inferior just below it, which is less distinct than the anterior; and to these ligaments are attached, tying the ileum to the sacrum and to the last lumbar vertebra. The interval between the anterior, superior, and anterior inferior, spinous processes gives transmission to the psoas magus and iliacus internus muscles. The outer part of the ileum is called the dorsum, and upon it there are several rough lines, elevations, and depressions, which give origin to the fibres of the gluteus medius muscle. There is also an imperfect semicircular ridge, about two inches below the crista, from which arises the gluteus minimus. The internal part of the ileum is hollowed, and forms the venter or fossa iliaca, which gives origin to the iliacus internus muscle. The venter is bounded

inferiorly by a line which commences at the os pubis ; it forms the brim of the pelvis, and is called the *linea ileo-pectinea vel innominata*. Below this line, posteriorly, there are two rough surfaces, the anterior of which immediately unites the ileum with the sacrum, and in shape somewhat resembles the human ear. To the posterior, large masses of ligament are attached, firmly tying the bones together, and effectually preventing motion in that part. The lower and anterior portion of the ileum forms the upper and outer part of the acetabulum. This part is smooth internally, for connexion with the head of the os femoris ; and rough externally, being marked by numerous little holes, into which the fibres of the capsular ligament of the hip joint pass, and get stronger hold. Posteriorly, between the lower part of the bone and the posterior inferior spinous process, there is an excavation, which, when the bone is united with the ischium, assists in forming a large portion of the sacro ischiatic, or sciatic notch. Upon the inner part of the bone, just above the *linea ileo-pectinea*, there are generally seven-

ral holes, and always a large one in particular, transmitting arteries nourishing the interior of the bone. There are also similar holes upon the dorsum, for the same purpose.

The Ischium.

This portion is placed perpendicularly beneath the ileum, and forms the lowest point of the pelvis upon which we sit. The upper part of it forms the lower and largest part of the acetabulum; this, like the ileum, is internally lined with a smooth articulating surface, for articulation with the head of the os femoris, and is also marked by the attachment of the capsular ligament externally. On a level with the lower part of the acetabulum, the spinous process is seen projecting backwards and inwards, and to it, the superior sacro-sciatic ligament and coccygeus muscle are attached. Below this process the bone becomes expanded, and forms the tuber ischii, upon the back part of which, the inferior sacro-sciatic ligament is inserted. The tuberosity is broader posteriorly than anteriorly, and to its most expanded part, the three flexors of the leg

are attached, *viz.* the biceps, semi-tendinosus, and semi-membranosus; whilst upon the narrow and anterior portion, the body rests in the sitting position. Between the broadest portion and the spinous process there is a groove, through which the obturator internus muscle leaves, and the internal pudic blood-vessels and nerves re-enter the pelvis. Between the tuberosity and the acetabulum there is a second groove, along which, the tendon of the obturator externus muscle passes to its insertion. Bounding the lower margin of this groove there is a rough and raised line, to which the quadratus femoris is attached. From the anterior part of the tuberosity the ramus or crus proceeds, ascending upwards and inwards, to meet the crus or descending ramus of the os pubis. The inferior edge of the crus is rough, giving attachment to the crus penis; whilst the superior edge is thin, where it forms a part of the foramen ovale, vel thyroideum. Upon examining the internal part of the tuberosity, an imperfect groove is seen, which continues its course along the inner side of the ramus

of the bone, and transmits the internal pudic artery. Whenever this vessel is wounded in the operation for lithotomy, a fatal hæmorrhage is always liable to ensue, and it can only be restrained by making firm and uninterrupted pressure for some hours, with the fore-finger a little padded. The finger must be passed through the wound in perineo, and firmly pressed upon the vessel, where it lies close in contact with the bone, in the groove we have just described. The surgeon to whose care the patient is committed should be frequently relieved by an able assistant.

The Os Pubis.

The os pubis, or third portion of the os innominatum, is the smallest of the three, and forms the most anterior part of the haunch bone. Upon the inner and fore-part there is a rough surface, which is contiguous with a ligamento-cartilaginous structure intervening between this bone and its fellow, and connecting them together; their junction constituting the symphysis pubis. About three quarters of an inch to the outer

side of the symphysis there is a tubercle, generally strongly marked, to which the pubic portion of Poupart's ligament is attached. The most external part of the bone forms the most internal part of the acetabulum, which, like the two other portions of the os innominatum, is rough externally, where it gives origin to the fibres of the capsular ligament, and has a smooth surface internally, for articulation with the head of the femur. That part of the bone intervening between the tubercle and acetabulum is called the body, which is excavated and smooth for the transmission of the femoral blood-vessels and nerves ; the artery being placed most externally. Upon the under part of the body of the bone there is a notch, which, when it is united with the ischium, forms the foramen ovale. This hole, in the recent subject, is completely filled up with a ligament, called the obturator, having a small opening at its upper part, for the transmission of the obturator blood-vessels and nerve. From the tubercle the linea ileo-pectinea commences, and uniting with the ileum it passes

backwards as far as the sacro-iliac symphysis, forming the brim of the pelvis. To the commencement of this line Gimbernat's ligament is attached ; and it likewise gives origin to the pectineus muscle. From the lower part of the symphysis, the ramus, or crus, commences, running downwards, outwards, and backwards, to unite with the ascending ramus of the ischium.

Os Sacrum,

Situated in the erect position, at the superior and posterior part of the pelvis, is somewhat triangular in shape, being expanded above and contracted below. Its anterior surface is tolerably smooth and concave, its posterior irregularly rough and convex. The centre of the bone is composed of a solid portion, called its body, which has, anteriorly, four transverse lines, indicating its original division into five pieces. The concavity of the sacrum not only increases the size of the pelvic cavity, but also favours the descent of the head of the child in parturition. The top of the body is considerably expanded, and projects

very much forwards, forming what is called the promontory or base, though, correctly speaking, this is more completely formed by the junction of the bone with the last lumbar vertebra, with which, it has a corresponding flat surface. Behind the promontory there are two articulating processes, which face a little towards each other, and receive the inferior articulating processes of the last lumbar vertebra. Anteriorly they are bounded by a groove, forming part of the last inter-vertebral foramina. On each side of the base there are two large transverse processes called the *alæ*, or wings of the bone; and upon each of *these*, an extensive surface, by which the bone is joined to the ileum, corresponding both in size and shape to the one spoken of when describing that bone; and forming what is called the sacro-iliac symphysis. Posteriorly to this junction ligaments are attached, called the sacro-iliac, firmly tying the bones together. Below the *alæ*, on each side, there are two abrupt projections of the bone, termed tubercles, giving attachment to the sacro-ischiatic ligaments. These projec-

tions or bumps may be observed all the way down the bone, being situated immediately in front of each sacral hole; they are the rudiments of the transverse processes, and most of them give origin to the fibres of the sacro-sciatic or ischiatic ligaments.

Upon the fore-part of the bone, on each side of the body, there are four foramina; and below the last foramina, a distinct notch or excavation, which, when the bone is joined to the os coccygis, is completed into a foramen, by means of a ligament. The three upper foramina are the larger, and transmit nerves which chiefly form the great sciatic, whilst the two smaller only give passage to nerves ramifying about the rectum, and parts in the neighbourhood. Upon the posterior surface of the bone, in the median line, there are four small eminences, the three lower of which are slightly connected to each other by small ossific extensions, whilst the first is quite detached, although this is not invariably the case. These eminences are the rudiments of the spinous processes, and constitute, in point of fact, the spine of the bone, which frequently

terminates in a projecting point, or most commonly in a bifid extremity: occasionally however, the spine is entirely wanting. Immediately beneath it is the continuation of the spinal canal, which is triangular in shape, and transmits the lower portion of the spinal marrow, which here receives the name of *cauda equina*. On each side of the spine there are four foramina, smaller, but corresponding to those upon the fore-part. These, in the recent subject, are nearly filled up with ligament, and merely transmit small blood-vessels, and the posterior branches of the sacral nerves. Upon the inferior extremity of the bone, there is an oblong flat articulating surface, which is connected with a corresponding articulating surface, upon the upper part of the *os coccygis*.

Os Coccygis,

So named from its resemblance to a cuckoo's bill, is, like the sacrum, triangular in shape; the base of the triangle being situated above and the apex below; whilst at the same time it curves forwards to support the extremity of the rectum. It is

placed immediately beneath the sacrum, to which it forms an appendix; and has upon its superior extremity an articulating surface, by which it is connected with the inferior extremity of that bone. This surface has upon each side, posteriorly, two processes, which project perpendicularly upwards, to be connected by ligament with the diverging processes of the spine of the sacrum. Passing horizontally outwards, and laterally, from these processes, there are transverse processes, to which ligaments are attached, extending to the inferior lateral bumps of the sacrum; and completing the last notches which appear in the skeleton, into foramina, transmitting the terminal branches of the cauda equina, after they have emerged from under the articular processes, to be distributed to the extremity of the rectum, and the parts in the neighbourhood. In the centre of the bone, as in the sacrum, there are three transverse lines, marking its original division into four pieces. Its use appears to be more particularly for supporting the extremity of the rectum, and preventing rupture of the perineum during

parturition. It likewise gives a partial origin to the gluteus maximus and coccygeus muscles ; and its point to the sphincter ani.

Formation of the Acetabulum.

This cotyloid, or cup-like cavity, which articulates with the head of the femur, is formed by three bones, already described ; viz. the *ileum*, *ischium*, and *os pubis*, although in unequal proportions. To have a more correct idea of the relative proportion of each individual portion of the os innominatum, the student should select one from a child, about ten years of age. He will then find that the *ileum* forms about two-fifths of the cup, the *ischium* rather more than two-fifths, and the *os pubis* a little less than one-fifth. This cavity is deepest at its upper and most external part, or more correctly speaking, posteriorly and inferiorly to the anterior, inferior, spinous process of the ileum, and most superficial above the foramen ovale, where its edge is deficient, leaving a notch, which is completed into a foramen by means of the transverse ligament,

through which the vessels nourishing the joint enter. The cavity itself is considerably deepened by a rim of cartilage, which, like the bone, however, is defective just above the foramen ovale.

*Formation of the Foramen Ovale,
vel Thyroideum.*

The thyroid, or obturator hole, is wholly formed by the ischium and os pubis. In the recent subject, as we have before stated, it is almost entirely filled up with the obturator ligament, except at the upper part, where an opening is invariably left, for the transmission of the obturator blood-vessels and nerve. Its principal use seems to be that of rendering the pelvis lighter, and also to allow the soft parts to recede a little from pressure, during the time that the foetal head is firmly impacted within the pelvic cavity.

*Formation of the Sacro-Sciatic, or
Ischiatic Notch.*

This notch is formed by the ileum, ischium, and os pubis, and occasionally the

os coceygis assists. By the addition of the sacro-ischiatic ligaments, it is completed into two foramina, one superior, and the other inferior. Of the two the superior is by far the larger, and through it the pyri-formis muscle quits the pelvis, and with it several important blood-vessels and nerves. Above the muscle, the gluteal artery, vein, and superior gluteal nerve; below it, the inferior gluteal nerve, the ischiatic artery, vein, and nerve, the internal pudic artery, vein and nerve, and the posterior superior cutaneus nerve. Through the lower opening the tendon of the obturator internus muscle leaves the pelvis, and the internal pudic blood-vessels and nerve re-enter that cavity; they then run along the groove we have mentioned, upon the inner side of the tuberosity and ramus of the ischium, to be distributed to the rectum, perineum, and the organs of generation.

Having described the bones of the pelvis, we shall now make a few brief remarks upon its general conformation and divisions.

Divisions of the Pelvis.

The pelvis in the adult is, as has been before stated, made up of four bones, *viz.* the ossa innominata, sacrum, and coccyx. It is divided into an upper and a lower space or circumference by means of the *brim*, which is formed on each side by the linea ileo-pectinea, or linea innominata, completed anteriorly by the symphysis pubis, and posteriorly by the base of the sacrum. The upper space or circumference has been very properly termed the *false pelvis*, from its belonging more strictly to the abdominal cavity; besides which, its osseous parietes are deficient anteriorly; its posterior and lateral being formed only of those parts of the ilia situated above the brim, and by the two inferior lumbar vertebræ, between which, and the crista of each ileum, there is a distinct notch. So that from the anterior, superior, spinous processes of those portions of the os innominatum to the symphysis pubis, the parietes are completed by the lateral muscles of the abdomen, which becoming tendinous at

that point, form the *linea alba*, extending from the symphysis to the ensiform cartilage of the sternum; by uniting with which the anterior median line of the body is rendered complete. The *false* pelvis is occupied in the female by the impregnated womb, which in that state, rests upon the *linea ileo-pectinea*, and also by the small intestines, situated behind the former. The inferior space, or *true* pelvis, is a large cavity of considerable depth, completely surrounded by bony parietes; and formed by those portions of the *ossa innominata*, below the *linea ileo-pectinea*, and also by the *sacrum* and *os coccygis*. It has a large aperture inferiorly, which is usually termed the *outlet*, and is bounded on each side by the *rami* of the *ischia* and *pubis*, extending upwards and forwards, from the *tuberosities* of the *ischia* to the *symphysis pubis*; and this union of the *rami*, constitutes what is termed the *pubic arch*. In addition to this aperture, there are two large notches, the *sacro-sciatic*; and two holes, one on each side, the *foramen ovale*. The two former are completed into larger and lesser spaces by the

sacro-sciatic ligaments, and transmit the parts we have before mentioned; the two latter are filled up by the obturator ligaments, and merely transmit the obturator blood-vessels and nerve. Besides affording passage for those important parts, these notches and holes render the pelvis much lighter, and allow of a considerable recession of the soft parts during difficult and laborious parturition.

Difference between the Male and Female Pelvis.

The marks of distinction between the male and female pelvis every student should be familiarly acquainted with, as their deficiency or deformity have a very important relation to the principles and practice of midwifery. Those characterizing the *male pelvis* are the following :

First, *its* greater depth and contracted diameter; secondly, *its* more strongly ossified bones, and consequently increased strength; thirdly *its* erect ilia, projecting and highly curved sacrum, and very narrow openings; fourthly, *its* more closely approximated ace-

tabula; the result of which is, that the thighs are brought more in a direct line with the body; and the step is rendered graceful and sure.

The characteristic differences of the *female pelvis* are, first, *its* lighter construction and greater breadth and capacity, owing to the comparatively increased expansion of *its* ilia, which are so thin in the centre, as to be almost semi-transparent; secondly, *its* larger and more circular superior aperture; thirdly, *its* broad and nearly straight sacrum; fourthly, the greater space between *its* ischial tuberosities, the comparative shallowness of *its* symphysis pubis, and consequently greater breadth of *its* pubic arch, and magnitude of *its* inferior aperture; and lastly, *its* more widely separated acetabula.

The consequence of this greater separation of its acetabula compared, with those of the male, is, that the thighs are more rounded, the knees are thus caused to approach each other, and the step is rendered unsure. Hence it is that women of the most beautiful form walk with a delicacy

and feebleness, which we come to acknowledge as a beauty in the weaker sex.

Articulations of the Pelvis.

Although there are four points of junction amongst the pelvic bones, *viz.* the sacro-iliac symphysis on each side; the symphysis pubis, and the sacro-coccygeal joint, yet, properly speaking, there is but one articulation, which is the last mentioned. The others in the male are frequently ankylosed; and even in the female there is only a slight yielding at the symphysis pubis, and a corresponding one at the sacro-iliac symphysis. It is better, therefore, to class them with the immoveable or *synarthrodial* articulations, although some authors mention them as belonging to the *diarthrodial* or *moveable*.

The sacro-coccygeal articulation, however is, in every sense, one of the *latter* class; motion being permitted backwards and forwards; and thus, during parturition, the outlet of the pelvis, by the recession of the coccyx, will be increased posteriorly to the extent of an inch.

SECTION IV.

BONES OF THE EXTREMITIES.

Description of the Bones of the Upper Extremity.

The upper extremity is divided into the *shoulder, upper arm, fore-arm, and hand.*

The bones of the shoulder are two in number; *viz. the scapula and clavicle.*

The Clavicle.

This bone is placed upon the upper part of the chest, extending from the sternum, nearly horizontally outwards, to the top of the shoulder. It is divided into a body and two extremities; *viz. a sternal, connected by*

cartilage to the sternum, and a scapular, which is articulated with the acromion process of that bone. The former is triangular in shape, the base of the triangle being placed above, and the apex below ; to this a ligament is attached, which crosses behind the first portion of the sternum, to the apex of the opposite clavicle, tying them to each other ; on which account it is called the inter-clavicular ligament. Upon the sternal extremity there is an articulating surface, which receives a cartilage, intervening between it and the first portion of the sternum ; the use of which is to facilitate the motions at that part. Upon the under part of the sternal extremity there is a rough surface, which gives origin to a ligament tying the bone down to the first rib. The body of the clavicle arches forwards and then backwards, being shaped like an italic *f*. The superior part of it presents a smooth and convex surface, which is merely covered by the fascia and common integuments ; whilst upon the under surface, there are usually slight elevations and depressions, which give origin to the fibres

of the sub-clavius muscle. The superior face of the sternal extremity is rough, and gives origin to the sterno-cleido mastoid-eus ; the anterior margin of it is also rough, and gives origin to the pectoralis major. The scapular extremity is much more flat and expanded than the sternal. Its anterior margin gives origin to the deltoid muscle, and its posterior to the trapezius. Upon this extremity there is a small flattened surface, by which, with the addition of cartilage, it is articulated to the inner side of the acromion process of the scapula. Upon the under part of the scapular extremity, there is a rough surface, giving attachment to a ligament, tying it to the coracoid process of the scapula. Upon the back part of the bone, near the shoulder, we find one, sometimes two foramina, transmitting the nutrient arteries of the bone.

The clavicle moves upwards and downwards, also backwards and forwards, according to the motions of the shoulder ; and by its throwing the scapula to one side, it considerably increases the movements of the upper extremity. It is the only con-

nexion by means of bone, of the upper extremity with the trunk.

The Scapula.

The scapula, or blade bone, is a thin bone, resting upon muscle, and connected to the trunk solely by means of the clavicle. It is situated obliquely upon the back part and sides of the chest, extending from the second rib to the seventh. It is irregularly triangular in shape, the base of the triangle being formed by the upper part of the bone, and the apex by the lower part. It possesses two surfaces, one anterior, and the other posterior; also three costæ or edges; and three angles. Its anterior surface or venter, called also fossa sub-scapularis is irregularly concave, and has several rough lines passing obliquely across it, which give origin to the fibres of the sub-scapularis muscle. Its posterior surface, called the dorsum, is irregularly convex, and is divided into two unequal spaces or fossa spinati, by means of the spine, a process we shall presently speak of. The upper space, which is the smaller, is called the fossa supra spinata,

and gives origin to the supra-spinatus muscle, the lower or largest is termed the fossa infra spinata, and gives origin to the infra-spinatus muscle. Its costæ are named from their situation : thus we find one superior, another posterior, and a third anterior. The superior, which is the shortest, is placed upon a level with the spine, and forms the upper boundary of the bone. The posterior is the largest, and has been likewise termed the base ; and the inferior, which is the next in size, is placed anteriorly. Its angles, like its costæ, are named from their situation, superior, anterior, and inferior. The superior angle is placed between the superior costa and upper part of the base ; the inferior, between the lower part of the base and inferior costa ; and the anterior, between the superior costa and upper part of the inferior costa ; this angle is covered by the glenoid cavity. The spine commences from the posterior costa or base ; it passes obliquely upwards and forwards, and becoming expanded anteriorly, it forms the acromion process. Upon the inner side of this process there is a small articulating surface,

by which it is articulated with the scapular extremity of the clavicle. The spine, superiorly, is surmounted by two rough edges, the anterior of which receives the insertion of the trapezius, whilst the posterior gives origin to the deltoid muscle. The anterior angle, as has been stated, is covered by the glenoid cavity; this is nothing more than an oval shallow depression, which is deepened in the recent subject by a rim of cartilage; and is covered with an articulating surface, for connexion with the head of the humerus. Around the edge of this cavity the bone is rough, being marked by the origin of the capsular ligament. At the upper part of it there is a small projection, which has received the name of tubercle, and gives origin to the long head of the biceps muscle. That part of the bone immediately posterior to the glenoid cavity is contracted, and forms the *cervix scapulæ*. From the inner and upper portion of the *cervix*, the coracoid process projects, passing nearly horizontally forwards; and at its extremity it becomes curved a little downwards, to give origin to the short head of the

biceps, and corico-brachialis muscles ; and also to receive the insertion of the pectoralis minor. To the inner side of the glenoid cavity, between the root of the coracoid process and superior costa, the notch of the scapula is situated. This, in the recent subject, by means of the posterior ligament of the bone, is completed into a foramen, transmitting the superior dorsal artery of the scapula, its accompanying vein and nerve : very frequently, however, the artery passes over the ligament, instead of going under it.

The base of the scapula, internally, receives the insertion of the serratus major anticus, externally, the rhomboidei ; its superior costa, the omo-hyoideus ; its superior angle, the levator scapulæ ; its inferior, a slip, occasionally, of the latissimus dorsi ; and in connexion with its inferior costa, gives origin to the teres major and minor, and triceps extensor muscles. The scapula moves upwards and downwards, also backwards and forwards ; and it may likewise be rotated upon its axis, thereby, more extensively increasing the motions of the arm.

The movements between this bone and the clavicle are much confined ; indeed their junction may be considered as a fixed point ; the clavicle serving as a shaft or axis, and its principal motions being performed at its articulation with the sternum.

*The Humerus, vel Os Brachii, or
Upper Arm.*

This bone intervenes between the scapula above and the fore-arm below, and is irregularly cylindrical in form. The upper part of it is much expanded, and is called its head. Upon it there is an extensive articulating surface, forming rather more than one-third of a sphere, which is received into the glenoid cavity of the scapula. Below the head, there are two projections, called tubercles, a greater and a lesser ; the former being situated upon the outer part of the bone, and is rather inclined posteriorly, the lesser, more anteriorly and inferiorly. Upon the greater tubercle, three surfaces are generally discernible, in some bones, of course, more distinct than in others; receiving the insertions of

the supra-spinatus, infra-spinatus, and teres minor muscles. Upon the lesser tubercle there is but one surface, which receives the insertion of the sub-scapularis. That part of the bone between the head and the tubercles, is somewhat contracted, and has been incorrectly denominated the cervix; this is both rough and porous, being marked by the origin of the capsular ligament of the shoulder joint. Between the two tubercles there is a large and deep groove, which extends one-third down the anterior surface of the bone. This groove has received the name of bicipital, from its transmitting the long head of the biceps muscle; which, arising, as we have before stated, from the tubercle, at the upper part of the glenoid cavity of the scapula, it runs over the head of the humerus, being covered by a reflexion of the synovial membrane, (as the student will find when he is dissecting the ligaments of the shoulder joint,) by which means it is excluded from the articulation; it then tracks the course of this groove, and about one-third down the arm, unites with the short head, arising from the point

of the coracoid process of the scapula, to form one large fleshy mass, which eventually becomes inserted into the tubercle of the radius, constituting the principal flexor of the fore-arm. The groove itself is bounded by two ridges, the anterior or outer of which receives the insertion of the pectoralis major ; and the posterior, or inner, that of the latissimus dorsi, or the muscles forming the boundaries of the axilla. The shaft of the bone, as it descends, has a twisted appearance, and inferiorly becomes very much expanded, terminating in two large processes, called condyles ; one projecting externally, and the other internally. Upon the middle and outer part of the shaft, there is a large rough surface, which receives the insertion of the deltoid muscle. Opposite to this, internally, there is a raised edge, which receives that of the corico-brachialis ; and just below it, the foramen transmitting the nutrient artery of the bone. Proceeding upwards from the condyles, there are two ascending oblique ridges, which form points of attachment for the inter-muscular ligaments. To the exter-

nal of these two ridges, in connexion with its condyle, the supinator radii longus and extensor muscles of the fore-arm are attached ; whilst to the internal ridge and condyle, the pronator radii teres, and flexor muscles of the fore-arm. Of the two condyles, the internal is much the largest, and has a projecting process, which gives attachment to the internal lateral ligament of the elbow joint. Behind this process there is a groove, transmitting the ulnar nerve. The external condyle is much less projectile, but gives origin to the external lateral ligament of the elbow joint. Upon the condyles, inferiorly, there are two distinct articulating surfaces ; the internal of these, corresponding with its condyle, is by far the most extensive, and forms a complete trochlear, or hinge, in connexion with the ulna. That upon the external condyle is convex, and forms a ball, which is received into a socket upon the head of the radius. Above the condyles there are two excavations or cavities, one before and the other behind. The one in front is the smallest, and receives the coronoid process

of the ulna, in flexion of the fore-arm ; whilst the posterior, of considerable magnitude, receives the olecranon process of the same bone, in extension of the fore-arm.

Formation of the Shoulder Joint.

The shoulder joint is one of the most perfect specimens of the *enarthrodial* variety alluded to, when speaking of the articulations in general (*pages 16 and 17*) ; and there described as constituting the first sub-division of diarthrosis. It is formed only of two bones, the scapula and os humeri. In consequence of the shallowness of the glenoid cavity, and the extensive articulating surface upon the head of the humerus, we find that the movements of which it is capable, are so free, quick, and easy, that motion may be effected in every direction, either upwards or downwards, backwards, or forwards, outwards, or inwards ; and in short, it may be rotated in every possible position. The joint itself, however, and as it appears in the articulated skeleton, is, in fact, too superficial to be strong ; and were it not for the scapula gliding easily

upon the muscles covering the ribs, and thus eluding force, it would much more frequently be in danger of being seriously injured from slight shocks or falls. Yet, naked as at first sight it really does appear, Nature has performed her part in endeavouring to screen it from injury; by supplying it with two strong processes, *viz.* the acromion and coracoid; and she has additionally strengthened it by strong ligaments, tendons, and muscles, more particularly by the deltoid, and those muscles which are inserted into the tubercles of the humerus.

The Fore-arm.

The fore-arm occupies the space between the humerus above and the hand below, and is composed of two bones, *viz.* the *radius* and *ulna*, the former passing down upon the outer side, and the latter upon the inner side.

The Radius.

This bone is shorter than the ulna by an inch. It is so named from its resemblance to the ray, or spoke of a wheel; and is situ-

ated not only external, but anterior to the ulna. It differs from that bone, in being contracted superiorly, and expanded inferiorly. The top of the bone is called its head, which is quite circular, and upon it there is a concave articulating surface, receiving the external condyle of the humerus. Upon the ulna side there is a convex surface, which is received into the lesser sigmoid cavity of the ulna. About an inch below the head, and inclined to the inner and back part, there is a tubercle, which receives the insertion of the biceps muscle, and capsular ligament of the joint. That part of the bone between the head and the tubercle is contracted, and forms the cervix, and to it, the coronary ligament is attached. The shaft of the bone is of a prismatic or triangular form, although less distinctly defined than that of the ulna. As it descends it increases in size, and inferiorly, as we have before stated, it becomes very much expanded, to be articulated with the carpus. The outer part of the shaft is generally smooth and convex, whilst upon the inner side, there is a sharp ridge, cor-

responding to that of the ulna, to which the inter-osseous ligament is attached. Upon the inferior extremity of the bone, there are two articulating surfaces, separated in the centre by a slight perpendicular groove, by which it is articulated with the two first bones of the carpus, *viz.* the os scaphoides and os lunare. Upon the ulnar side of the lower extremity, there is a small and slightly excavated articulating surface, called the sigmoid cavity of the radius; it receives the head of the ulna. The outer side of the lower extremity is a little lengthened by a projecting point, called the styloid process, which gives origin to the external lateral ligament of the wrist joint, and forms a guide for opening the joint, in amputation. Upon the fore-part of the lower extremity there is a somewhat flattened surface, extending upwards, to about two inches, and giving attachment to the pronator radii quadratus muscle. Upon the lower extremity, posteriorly, there are two large grooves, separated by a raised projection; the external of which transmits the radial extensors and supinators of the hand; and

the internal, the tendon of the extensor digitorum communis. The opening for the principal nutritious artery, is placed upon the fore-part of the bone, generally a little more than one-third down.

The Ulna,

Situated upon the inner side of the fore-arm, is the longer of the two ; and is so named from its being often used as a measure. It is much expanded superiorly, and considerably contracted inferiorly. It is lengthened at its upper and back part by the olecranon process, which receives the insertion of the triceps extensor cubiti muscle, and partially that of the anconeus. Upon the fore-part of the bone, about an inch below this process, there is a smaller one, which, from its supposed resemblance to a crow's beak, has been called the coronoid ; it receives the insertion of the brachialis internus muscle. Between these two processes there is a large and deep cavity, which is said to resemble, in profile, the Greek letter σ sigma, and has, therefore, received the name of greater sigmoid cavity

of the ulna; the term greater being added, to distinguish it from a smaller, but similar one, situated immediately upon the outer side of the coronoid process, and rather inferior to the larger cavity, and called the lesser sigmoid cavity of the ulna. Both of these cavities are covered with articulating surfaces; the larger, for connexion with the internal condyle of the humerus, which it embraces so closely as not to permit of the smallest degree of lateral motion; the lesser allows the round head of the radius to roll upon it, in the rotatory motions of the fore-arm. Upon the back part, below the olecranon process, there is a smooth and somewhat triangular portion of the bone, which is merely covered by the fascia and common integuments. Upon the fore and outer part of the bone, below the lesser sigmoid cavity, there is a small projection, which gives attachment to the oblique ligament, tying the ulna to the radius. The body or shaft of the bone is triangular, and as it descends it becomes gradually narrower; and then at its lower extremity, it again expands a little, to form its head,

which is articulated, by means of cartilage, to the carpus. The inner part of the shaft of the bone is perfectly smooth and convex ; but on the radial side there is a sharp ridge, to which, one side of the inter-osseous ligament is attached. The lower end of the head has a flat surface, by which it is joined to the saxiform cartilage. This cartilage intervenes between it and the os cuneiforme ; and thus it is that the ulna is excluded from the wrist joint. On the radial side of the head, there is a convex articulating surface, which is received into the sigmoid cavity of the radius, whilst upon the inner side, the bone is lengthened by the styloid process, which gives origin to the internal lateral ligament of the carpus. Upon the fore-part of the lower extremity there is a flat surface, extending upwards about two inches, which gives origin to the pronator radii quadratus muscle. Upon the back part there is a distinct groove, situated between the styloid process, and that part of the bone which is received into the sigmoid cavity of the radius ; it transmits the tendon of the extensor carpi ulnaris.

The foramen for the principal nutritious artery, is placed upon the fore-part of the bone, about one-third down.

Formation of the Elbow Joint.

The elbow joint, a compound articulation and an excellent example of the third variety of diarthrosis, termed *ginglymus*, is, in fact, one of the most complicated articulations in the whole body, inasmuch as it is composed of three different joints, all of which may be said to be inclosed in one continuous capsule; although many distinct ligamentous bands are spoken of by anatomists in their description of the ligaments. It is formed by three bones, *viz.* by the condyles of the humerus and superior extremities of the radius and ulna. The first joint which exists between the olecranon of the ulna and internal condyle, is a true example of the *angular ginglymus* alluded to in our general outline of the articulations; and constituting a perfect *trochlear* or *hinge*, admitting only of flexion and extension. In the second joint, the connexion between the radius and ulna, is by an

imperfect ball and socket, which circumstance, characterizes it as an *enarthrodial* articulation ; and it is one in which the articulating surfaces are so nicely fitted to each other, that the radius not only rotates upon the external condyle of the humerus, but also moves backwards and forwards with the ulna, in flexion and extension ; and yet, let the arm be ever so much flexed, the head of the radius will continue to rotate upon the external condyle, with the same degree of facility, as if it were in the semiflexed position. In the third articulation we find that the articulating surface, which surrounds the head of the radius laterally, is received into the lesser sigmoid cavity of the ulna ; and thus it constitutes the second variety of the *ginglymoid diarthrosis*, which has received the name of *lateral rotatory ginglymus*. Independently of these distinct articulations, there is yet a fourth ; which is so intimately connected with, and subservient to the last described, that notwithstanding it is situated between the same bones, at the inferior extremity of the fore-arm, it may, without impropriety, be considered as be-

longing to the articulation of the elbow. In this joint, however, we find the very opposite order of arrangement to that of the last ; for here the radius, instead of being received into the sigmoid cavity of the ulna, as above, has itself a sigmoid excavation, which receives the convex head of the ulna ; and it is on this account, that it has received the appellation of *double lateral*, or *rotatory ginglymus*, to distinguish it from that of *single* ; an example of which we have before adduced, when speaking of the articulations of the atlas (*vide page 108*). The wisdom and ingenuity which is displayed in this articulation of the radius, is well worthy of observation ; for it must be very obvious from such a disposition of parts, that *the ulna is a fixed point* ; and that it is by the radius rolling upon it, both superiorly and inferiorly, that supination and pronation, and all those varied movements of the hand, which so characterize the upper limbs, as organs of prehension, are effected.

BONES OF THE HAND.

The hand is divided into the *carpus*, or upper portion; *meta-carpus*, or middle portion; and the *fingers*, or third portion, placed inferiorly.

The *carpus*, or upper portion, placed between the fore-arm and meta-carpus, is composed of eight small bones, which are arranged in two rows, each row consisting of four bones, as follow: commencing on the radial side of the carpus, we find

<i>In the First row,</i>	<i>In the Second row,</i>
1. <i>os scaphoides,</i>	5. <i>os trapezium,</i>
2. — <i>lunare,</i>	6. — <i>trapezoides,</i>
3. — <i>cuneiforme,</i>	7. — <i>magnum,</i>
4. — <i>pisiforme,</i>	8. — <i>unciforme.</i>

These bones are so curiously disposed, that the dorsal portion of the carpus is rendered convex, whilst the palmar is concave and irregular, being marked by four bony prominences, across which is stretched the anterior annular ligament; forming a canal for the passage of the flexor tendons, in their course, to be inserted upon the pha-

langes of the fingers. The bones themselves are very firmly tied together by numerous bands of ligaments, making the whole, a sort of ball or nucleus, a solid foundation or centre for the rest of the hand.

Description of the first row of the Carpal Bones, and their connexions.

1. *Os Scaphoides.*

This bone, situated upon the radial side of the carpus, is so named from its boat-like cavity. It is convex above, where it is received into the concave articulating surface, upon the lower extremity of the radius; and concave upon its ulna side, to receive partially the head of the os magnum. Inferiorly, upon its radial side, it has a projecting point, upon which the external lateral ligament of the wrist joint is inserted; and likewise upon its posterior surface, inferiorly, there is an articulating surface, which is in contact with the trapezium, trapezoides, and magnum. Immediately above this surface there is a groove, for the attachment of ligaments.—Its *connexions*

then are as follow : superiorly it is articulated with the lower extremity of the radius ; inferiorly, with the trapezium, trapezoides, and magnum ; and upon its ulna side, with the os lunare.

2. *Os Lunare.*

This bone is so named from its outer side resembling in shape a crescent or half moon. It is placed upon the ulna side of the scaphoid, and is irregularly triangular in form. It is convex above, where it is connected with the articulating surface upon the lower end of the radius ; and concave below, where it joins the magnum, and partially, the unciforme bones. There is a flat surface upon its radial side, uniting it with the scaphoid ; and another upon its ulna side, which, in the natural situation of the bone, looks inferiorly, connecting it to the cuneiforme bone. *Connexions* : it is articulated above, to the radius ; below, to the magnum and unciforme ; upon its ulnar side, to the cuneiforme bone ; and upon its radial side, to the scaphoid.

3. *Os Cuneiforme.*

So named, more from its situation than from its being strictly wedge shaped. It is placed directly below the ulna, on the inner side of the os lunare, and immediately above the unciforme bone. The space seen in the articulated arm, between the lower end of the ulna and this bone, is occupied by the intervention of the saxiform cartilage. The posterior portion of the bone is irregular, uneven, and broader than the inferior; and so far only it may be said to be wedge shaped. It is somewhat flat superiorly, where it is opposed to the saxiform cartilage, and has likewise a flat articulating surface upon its radial side, where it joins the os lunare. Inferiorly, there is a slightly concave articulating surface, by which it is connected with the unciforme, and anteriorly a small flat and circular surface, upon which the pisiforme bone rests.—*Connexions*: on the radial side, it is articulated with the os lunare; above, with the saxiform cartilage; anteriorly, it supports the pisiforme; and inferiorly it joins the unciforme bone.

4. *Os Pisiforme,*

So named from its resemblance to a pea, is situated upon the inner side of the palm, resting by a flat articulating surface posteriorly, upon the cuneiforme bone. It is the most prominent of all the carpal bones, and stands so much out of its rank, as to be readily felt by the hand. It forms the inner pillar of that arch, under which the flexor tendons of the hand pass to their insertion. The arch itself is formed by the anterior annular ligament of the carpus, which, arising from the projections upon the scaphoid and trapezium, passes to be inserted upon this little bone. In addition, it receives the insertion of the flexor carpi ulnaris, one of the chief muscles flexing the carpus.

*Description of the Second Row, and their
Connexions.*

5. *Os Trapezium.*

From its name we might suppose that it was of a square shape, when in fact it is the most irregular of all the carpal bones; especially when detached from the others.

It is situated below the scaphoid, but more inclined to its radial side. Upon the fore-part there is a rough projecting process, which receives the insertion of the external lateral ligament of the wrist joint. Inferiorly, there is a smooth surface, which is convex from before to behind, and concave from side to side, supporting the meta-carpal bone, or first phalanx of the thumb. To the ulna side of this surface, inferiorly, there is a very small portion of an articulating surface, by which it partially supports the meta-carpal bone of the fore-finger. Superiorly, there is a third articulating surface, equally divided by a prominent ridge into two parts : *that* inclined to the left side is connected with the inferior surface of the scaphoid ; whilst *that* upon the right, joins the trapezoides.—*Connexions* : above, it is articulated with the scaphoid ; upon its inner side, with the trapezoides ; below, to the meta-carpal bone of the thumb, and in part to that of the fore-finger. The peculiar conformation of the articulating surface by which it is connected with the thumb, renders it a *double ginglymoid joint*, flex-

ion and extension being permitted, not only from side to side, but also from before, backwards.

6. *Os Trapezoides.*

So named from its supposed resemblance to the trapezium. It, however, much more resembles the cuneiforme bone of the first row, both in form and situation; being wedged in between the trapezium and magnum, and in the broadest part, being situated posteriorly. It has articulating surfaces upon all sides, by which its several connexions are maintained. They are as follow: above, it is articulated with the scaphoid; on its radial side, with the trapezium; on its ulnar side, with the magnum; and below, it supports the meta-carpal bone of the fore-finger.

7. *Os Magnum.*

So called from its being thought to be the largest of all the carpal bones, which is not the case, for the scaphoid and cuneiforme bones are as large. As, however, it is not distinguished by any other peculiarity, except-

ing its round head, it still retains the same name. It is placed in the centre of the second row, between the trapezoid and unciforme bones.—*Connexions* : superiorly, it has a rounded process, called its head : this is covered with an articulating surface, which is received into a cavity, formed by the scaphoid and lunar bones. Inferiorly there is another surface, which supports the metacarpal bone of the middle finger, and partially that of the ring finger. Upon its radial side, it is articulated with the trapezoides ; and upon its ulna side, with the unciforme bone.

8. *Os Unciforme.*

This bone is so named from its hook-like process, which receives the insertion of the anterior annular ligament of the carpus. It is placed upon the ulna side of the magnum ; and appears, in the articulated hand, to be wedged in between that bone and the os cuneiforme of the first row.—*Connexions* : It has an articulating surface superiorly, or, more correctly speaking, upon its ulna side ; by which it is connected with the cunei-

forme bone. Upon its radial side there is a second surface, by which it joins the magnum; and inferiorly there is a third, which supports the meta-carpal bone of the ring and little fingers.

This, then, completes the description of the carpal bones, and their relative connexions with each other. Although eight in number, they are so firmly consolidated together, as to appear to form but one great joint; and are seldom or scarcely ever luxated. They are all somewhat wedge shaped, having their broadest ends situated posteriorly, and their smaller ones towards the palm, which accounts for the convexity of the carpus, posteriorly. In their arrangement they have frequently, and not improperly, been compared to the stones of an arch; and they certainly require very extraordinary force to beat them in.

Formation of the Wrist Joint.

The articulation of the wrist is formed by three bones, *viz.* the lower extremity of the radius, and the scaphoid and lunar bones; the former constituting the socket,

and the two latter an imperfect ball. These bones are firmly maintained in apposition by the addition of strong capsular and lateral ligaments; and the joint very materially strengthened by the passage of the flexor and extensor tendons. It is a *double ginglymoid* articulation, admitting not only of flexion and extension, but also of lateral motion.

The Meta-carpus,

Or middle portion of the hand, occupying the space between the carpus and phalanges, is formed of five long bones, which are articulated to the carpal. Properly speaking, however, there are but four, the thumb being described by many anatomists as having no meta-carpal bone, but the same number of phalanges as the fingers. What was formerly considered as the meta-carpal bone, is now regarded as the first phalanx; and certainly it much more resembles the latter than the former. The carpal and meta-carpal bones, considered together, resemble a part of a wheel; the former being closely grouped into one mass, may be

said to form the nave ; and the latter, diverging or radiating from this centre, the spokes. The advantage of such an arrangement is most obvious, for not only are the fingers allowed greater play, but more complete flexion and extension, as well as a slight degree of rotatory motion is permitted.

The meta-carpal bones, cylindrical in form, are tolerably compact in their structure. They are convex posteriorly, and concave anteriorly ; and thus they correspond to the shape of the carpus, and deepen the palm of the hand. They diminish in size and length, and decrease in both, from the first to the last. They are divided into bases, bodies, and heads. The bases are those portions placed superiorly, which, with the exception of that of the first bone, are articulated by means of flat surfaces, with the carpal bones, constituting the *arthrodial* variety of the *diarthrodial* articulations, which we have described at page 17. The heads are those expanded portions placed inferiorly, which are convex ; and are covered with articulating surfaces, for articulation with the first row of pha-

langes. These surfaces will be found to extend farther over their palmar, than upon their dorsal aspect; a disposition which allows the fingers being brought into a more complete state of flexion. The bodies are those portions which, contracted more superiorly than inferiorly, intervene between the two former. The heads are all marked by the attachment of the small capsules in which they are enclosed. The spaces between the bodies are filled up by the inter-osseous ligaments and muscles.

The meta-carpal bone of the fore-finger differs from the rest, inasmuch as it is larger; and instead of the articulating surface upon its base being flat like the others, we find that it is concave, corresponding with the convexity of that, upon the inferior surface of the trapezoid bone. The radial side of the base has also a small articulating surface, by which it just touches the os trapezium. The remainder of the meta-carpal bones have articulating surfaces on both sides of their bases (with the exception of the last), by which they are joined to each other.

The Bones of the Fingers.

Each finger possesses three *divisions* or *phalanges*, so called from their being arranged in rows, which decrease in size, inferiorly. Considering the thumb as having no meta-carpal bone, and thus following the description of Winslow and other great anatomists, we state that the fingers consist of fifteen bones, or three portions each.

The *phalanges*, like the meta-carpal bones, are convex and smooth, posteriorly; and concave anteriorly. Into the concave part the flexor tendons are inserted. They are likewise divided into bases, bodies, and heads. The bases are placed superiorly, the heads inferiorly, and the bodies are the intervening portions.

The bases of the first row possess excavations or sockets, for the reception of the round heads of the meta-carpal bones, forming imperfect *enarthrodial* articulations; yet notwithstanding this disposition of the articular surfaces, so strongly are they bound to each other by ligamentous bands, that very little more than flexion, extension, and lateral motion are permitted.

The heads of the first row are distinguished by possessing two semicircular articulating surfaces, separated from each other by a central depression. These surfaces, like those upon the heads of the meta-carpal bones, extend more upon their palmar than upon their dorsal aspect ; and thereby allow of a more complete degree of flexion of the fingers. The bodies differ from those of the meta-carpal bones, in being more expanded superiorly than inferiorly.

To this characteristic description of the first row, we find that the first bone of the thumb, which we prefer reckoning as a phalanx than as a meta-carpal bone, is an exception. This bone, however, differs from the rest of the phalanges, inasmuch as it is both thicker and stronger, although in its general contour it more strictly resembles a phalanx. It possesses, in addition, an articulating surface, superiorly, corresponding to that upon the trapezium, only that its convexity and concavity are exactly reversed ; and thus it is that a *double ginglymus* is formed, allowing of the same kind of motion in two opposite directions.

The second row of phalanges, only differs from the first in the bones being smaller, and in having their bases lengthened posteriorly by slightly raised eminences ; which, when the fingers are straightened, *hitch* against the articulating surfaces upon the heads of the first row, and thus effectually prevent the fingers being extended beyond a certain limit. If the articulated hand be referred to, these little processes will be seen to over-hang, as it were, the heads of the phalanges above them ; and so well are the parts adapted to each other, that it requires a very considerable degree of force to displace them. Besides which, they form guides in amputation of the fingers ; a very necessary fact to be borne in mind, for without the surgeon was aware of the extent to which they overlap the heads of the phalanges above them, he would be completely foiled in his attempts to finish an operation, which is otherwise, with the knowledge of this peculiarity, rendered the most simple in its nature, and the most easy in its performance.

The peculiarities of the last row of phalanges are their diminished size, compared with those of the second row, and their spongy extremities, which are much rounded off and expanded, to give form and beauty to the hand.

Ossa Sesamoidea.

In the adult hand, we frequently find three or more of these bones, and likewise in the foot. They do not properly belong to the skeleton, but are generally found in parts which are much exposed to pressure. Thus, for instance, it is usual to find two at the articulation of the meta-carpal bone of the thumb, with its first phalanx; sometimes a third, in the corresponding joint of the fore-finger; and occasionally a fourth, at the root of the little finger. In speaking of the bones of the foot, we shall have to notice them in similar situations, where they are generally more numerous.

DESCRIPTION OF THE BONES OF THE
LOWER EXTREMITY.

The lower extremity is made up of three parts, *viz.* the *thigh*, *leg*, and *foot*.

The thigh consists but of one bone,

The Femur.

This bone is the largest, strongest, and longest, in the whole body; and is the most regular of all the cylindrical bones. It is divided into a central part, or body, and two extremities.

The upper extremity, which is nearly spherical, is called its head, or axis; and is covered with an articulating surface, constituting nearly two-thirds of a sphere; which is most extensive superiorly, and thus corresponding with that upon the acetabulum. Inclined a little to the inner side of the centre of this surface, there is an excavation, or pit, into which the ligamentum teres is inserted, tying the head of the bone to the acetabulum. Immediately behind the head, the bone becomes contracted, and forms

the cervix, which passes obliquely downwards and outwards, to be united with the shaft or body of the bone, at the distance of about an inch and a half, or two inches from its commencement; its union being indicated by two oblique lines. This part of the bone receives, almost at all times, the whole weight of the body; and were it not for the oblique direction which it takes, it would perhaps be much more subject to fracture than it is. Around the head, the bone is exceedingly rough and porous, especially at its upper part, being marked by the attachment of the synovial membrane and capsular ligament of the joint, and by the passage of small arteries nourishing the head. The neck of the femur is exceedingly well defined, and much more strictly deserves the name than that of any other bone. It passes off at nearly right angles with the body, thereby rendering the motions of the limb free and extensive, and unembarrassed by the pelvis. At its termination there is a large process, called the trochanter major; which is placed a little below the level of the head of the bone, but

nearly on a line with the centre of its axis. It receives the insertion, superiorly, of the gluteus medius ; and anteriorly, that of the gluteus minimus. At the root of this process, posteriorly, there is a small but deep depression, into which the five rotator muscles of the thigh are inserted, *viz.* the gemini, obturatores (internus and externus,) and the pyramiformis. To the inner and back part of the bone, about two inches below the great trochanter, there is another process, which is called the trochanter minor ; and upon it, the psoas magnus and iliacus internus muscles are inserted. Upon the back part of the bone, between the two trochanters, is seen an oblique ridge, which receives the insertion of the quadratus femoris. There is a corresponding ridge in front, before spoken of, which marks the junction of the cervix with the shaft, and the attachment of the capsular ligament. The body or shaft of the bone becomes narrower and more cylindrical as it approaches the centre ; and in this course slightly arches forwards. It is smooth and convex anteriorly, and is here covered by the extensor muscles of the leg,

more particularly by the reetus and crureus; whilst posteriorly it has a prominent ridge, called the *linea aspera*. This ridge commenees at the upper part of the bone, by two lines, the external of which arises from the trochanter major; the internal, from the junction of the lower part of the neck of the bone with the shaft, about three quarters of an inch anterior to the trochanter minor: they then descend obliquely, and at about one-third down unite, and form the rough edge we have described, which takes its course directly downwards, and about the lower third of the shaft again bifureates into two lines, much more smooth than those above; one passing obliquely outwards, to the external condyle, and the other obliquely inwards, to the internal condyle. Upon the line proceeding from the great trochanter, the *gluteus maximus* is inserted; upon that arising anterior to the lesser trochanter, the *pectineus* and *adductor brevis*. The remainder of the *linea aspera* receives the insertion of the *adductor longus*, and also gives origin to the *vasti*.

The inferior extremity of the bone is much more expanded than the superior, and is distinguished by two projecting processes, called its condyles; the internal of which is much the largest, and possesses a prominence or tuberosity, which receives the insertion of the adductor magnus. Above the condyles the bone is rough and porous, being marked by the attachment of the capsular ligament of the knee joint. The condyles, inferiorly, are covered by two very extensive articulating surfaces, for connexion with the head of the tibia, united anteriorly by a depression, which is concave from side to side; constituting a complete trochlear, or pulley, into which the patella is received. Extending backwards, these surfaces diverge, leaving between them a very large and deep cavity, which gives origin to the crucial ligaments, and receives a bifid tubercle, projecting from the head of the tibia. After diverging, they ascend very much upon the condyles, posteriorly; a disposition which permits the leg to be completely bent upon the thigh. Above the condyles and the deep

cavity we have described there is a smooth and triangular space, called the poples or ham; lodging the popliteal artery, vein, and nerve, the artery being situated nearest the bone. This space is very accurately bounded on each side by the lines proceeding from the inferior divergence of the linea aspera, to the two condyles; inferiorly, by the condyles themselves; and, in the recent subject, by the museles which form the hamstrings, *viz.* the biceps upon the outer side, and the semi-tendinosus and semi-membranosus, assisted by the gracilis and sartorius, upon the inner side. The internal condyle, it will be observed, descends much lower than the external, a provision which compensates for the obliquity of the shaft of the bone, in its natural position, when the two condyles are brought to the same plane; and which is obviously necessary when we take into consideration, that the heads of the femurs are separated by the whole width of the pelvis above, whilst their inferior extremities are brought to a point, so as almost to touch each other. Now this could not be the

case unless the internal condyle descended lower than the external ; the symmetry of man's form would be incomplete, and progression rendered exceedingly awkward. The external condyle projects further forwards than the internal, and on this account has been thought by some anatomists to be the largest. Its external surface, which is rough and unequal, has, posteriorly, a small depression, which gives attachment to the tendon of the popliteus muscle. The foramen for the transmission of the principal medullary artery is situated upon the back part of the bone, a little more than one-third down. This opening takes a slanting direction upwards.

Formation of the Hip Joint.

This articulation, which is formed by the head of the os femoris and the acetabulum, is one of the most perfect specimens of *enarthrosis* in the whole body ; permitting of motion in every direction. Thus, we have flexion and extension, adduction and abduction, and also rotation. Like the shoulder joint, it is very materially strengthened by

the strong muscles, which are inserted into the bone, contiguous to its head.

BONES OF THE LEG.

The bones of the leg are three in number, *viz.* the *patella*, situated above; the *tibia*, upon the inner side; and the *fibula*, upon the outer side.

The Patella.

This bone is situated at the anterior part of the knee joint, being attached to the upper part of the tibia by the strongest ligament in the whole body, the ligamentum patellæ; so that its position is variable, being influenced by the movements of the tibia. It is cordiform or triangular in shape; the base of the triangle being placed superiorly, and the apex inferiorly. The base is somewhat flattened superiorly; and upon it, and the sides of the bone, the four extensor muscles of the leg are inserted; *viz.* the rectus, crureus, and the two vasti; whilst the apex gives origin to the ligamentum patellæ. This ligament possesses such amazing strength, that the bone is

almost always fractured, sooner than the ligament will become ruptured or give way. Anteriorly, the patella is convex and porous, but posteriorly it has two somewhat concave articulating surfaces, separated by a vertical ridge; this ridge is received into the depression between the condyles of the femur anteriorly. Of the two surfaces, the external is said to be the largest; they correspond to those upon the femur.

The Tibia.

This bone, as we have before stated, passes down upon the anterior and inner side of the leg; and next to the femur, is the largest in the whole skeleton. Like that bone, it is divided into a body and two extremities. The superior extremity, called its head, is thicker and much more expanded than the inferior; and is of a spongy structure compared with the body; it is likewise rough and porous, being marked by the attachment of the capsular ligament of the knee joint; and also by the passage of small vessels, supplying that part of the bone with blood. Superiorly, the head is

surmounted by two extensive articulating surfaces, which correspond to those upon the condyles of the femur; and upon which the latter rest. The innermost of these surfaces is of an oval shape; the outermost is rounded or circular. Between them a bifid tubercle projects, which is received into a notch, between the condyles of the femur. In front of this tubercle there is a depression, and a similar one behind; and into these depressions the anterior and posterior crucial ligaments are inserted. Upon the fore-part of the bone, about an inch below the head, there is a considerable rising of the bone, which has been called the proper tubercle of the tibia; and upon it the ligamentum patellæ is inserted. Upon the outer and back part of the head of the bone there is a small and flat articulating surface, which faces obliquely downwards; and with which the head of the fibula is articulated. Extending obliquely downwards from this surface, across the upper and posterior part of the shaft of the bone, there is a rough line, which receives the insertion of the popliteus muscle.

The shaft of the bone is of a prismatic or triangular form, being characterized by three distinct sharp edges; *viz.* an anterior, an external, and an internal. The anterior, by far the most prominent and defined, is in common language termed the *shin*. It commences, as may be seen, upon the outer side of the proper tubercle; it then takes a waving course downwards, and about the lower third of the shaft, inclines to the inner side, and becomes almost insensibly lost upon the internal-malleolus, a process we shall presently speak of. The external is turned towards the fibula; and upon it the fibula side of the inter-osseous ligament is inserted. It commences superiorly from the articulating surface, which receives the head of the fibula: it then passes perpendicularly downwards; and about two inches from the lower extremity of the bone generally bifurcates into two; one passing to the anterior, the other to the posterior side of the lower extremity. Between this bifurcation there is a somewhat triangular excavation, called the semi-lunar cavity; which is concave from side to side,

and transmits the lower extremity of the fibula, in its course to form the external malleolus. The internal, or posterior, as it is likewise termed, is situated upon the inner and back part of the bone, and receives the insertion of the internal lateral ligament of the knee joint. It commences from the inner and posterior side of the head of the bone; it then descends nearly perpendicularly downwards, towards the back part of the internal malleolus. It gives origin to some of the flexors of the foot. The shaft of the bone, descending from the head, becomes gradually contracted till it approaches the lower third, and it is at this part that the leg is most frequently fractured; from thence it again begins to expand, to be articulated with the tarsus. The inner side of the shaft is smooth and convex, being here merely covered by the common integuments, fascia, and periosteum; whilst the outer side is slightly concave, and lodges the *tibialis anticus* muscle. The lower extremity of the bone is nearly quadrilateral in form, and is, anteriorly, smooth and convex, where it gives attachment to

the anterior, or tibio-tarsal ligament; whilst posteriorly it is flat, and is marked by a groove, near to its inner side, which transmits the tendon of the flexor longus pollicis. Externally, we find the semi-lunar cavity we have before described, as transmitting the lower extremity of the fibula; and internally, the bone is lengthened by a descending process, called the internal malleolus, also before spoken of; which is articulated with the inner side of the astragalus, or first bone of the tarsus. Around the lower extremity the bone is slightly rough and porous, being here marked by the attachment of the capsular ligament of the ankle joint. Upon the inferior extremity there is an extensive articulating surface, concave, and also quadrilateral in form, corresponding to that upon the head of the astragalus; which not only extends upon the side of the internal malleolus internally, but also over the semi-lunar cavity, receiving the fibula externally. The foramen for the principal medullary artery, is placed upon the back part of the bone, about one-third down; and the student will observe that it

differs from that of the femur, in its taking a slanting course downwards. The tibia has been compared, in shape, to a musical pipe; the head resembling the trumpet, and the lower extremity, the flute end of it; the mouth-piece being formed by the internal malleolus.

The Fibula.

This bone, so called from its supposed resemblance to a Roman clasp, is a long and slender bone, situated upon the outer side of the tibia, and is nearly equal to it in length. Its use is to strengthen that bone, to serve as a point of origin for several muscles; and more particularly to form the ankle joint. Its direction is nearly vertical, the lower extremity, however, inclining a little forwards; it lies beside the tibia like a splint and in disease of that bone it not only preserves the form of the leg, but also forms its chief support; although it is quite unconnected with the knee joint. Like the tibia and femur, it is divided into a body and two extremities. The upper extremity, which is somewhat expanded, is called its

head ; and upon the inner side of it there is a flat articulating surface, connecting it to the outer side of the head of the tibia ; to which it is firmly tied by strong ligaments. Upon the top of the head there is a rough projecting tubercle, giving attachment to the biceps flexor cruris muscle, and external lateral ligament of the knee joint. The shaft or body of the bone, like that of the tibia, is triangular ; being bounded by three prominent lines, *viz.* an anterior, a posterior, and an internal. The latter receives the insertion of the inter-osseous ligament, and anteriorly, gives origin to the extensor digitorum communis, extensor proprius pollicis, and peroneus tertius muscles ; and posteriorly, to the tibialis posticus. The posterior gives origin to the soleus, and flexor longus pollicis ; and the external, to the peronei muscles. The inferior or tarsal extremity of the bone becomes considerably expanded, and forms the external malleolus, which is received, as we have before stated, into the semi-lunar cavity, upon the outer side of the lower extremity of the tibia. Upon the inner side of this process, there is

an articulating surface, by which it is connected to the outer side of the astragalus. The lower-most point of this process has been called by some anatomists the coronoid, from its descending lower down than the internal malleolus. It gives origin to ligaments tying it to the bones of the tarsus. Behind it there is a shallow groove, transmitting the tendons of the peroneus longus and brevis. The foramen for the principal nutritious artery, is situated upon the back part of the bone, a little above its middle. This canal, like that of the tibia, slants obliquely downwards.

Formation of the Knee Joint.

This joint, which is formed by the condyles of the femur, head of the tibia, and the patella, is one of the purest specimens of the *angular*, or first variety of *ginglymus*, described at page 17. The patella, as we have before mentioned, glides in a pulley, formed between the condyles of the femur, anteriorly; and its projection upon the knee, removes the acting force from the centre of motion, so as to increase the

power. The mechanism of this articulation is so beautifully contrived, that while the knee is bent, and the muscles at rest, the patella sinks down into a hollow, formed by the separation of the anterior part of the condyles of the femur, from the head of the tibia; as may be seen by placing these bones in contact, and flexing them to a right angle; the anterior part of the joint, in the absence of the patella, is then quite unprotected, and a large cavity exposed, into which that bone is received. As soon, however, as the muscles begin to act, the patella rises from this hollow, and continues to do so in proportion to their degree of contraction; at the same time that it increases their power. When the contraction is perfect, we find that the patella has attained the summit of the knee; and thus it is, that the mechanical power of the joint is augmented; for the muscles, when contracted to their utmost extent, become, as it were, fixed points; and the patella, being attached to the head of the tibia by ligament, forms the pulley, which, gliding upwards and downwards, upon the condyles of the fe-

mur, anteriorly, according to the actions of the flexor and extensor muscles, constitutes the effective instrument, of the movements of the leg.

From this explanation it will appear, that the patella has two fixed points, one of which (its attachment, by ligament, to the head of the tibia) is permanent, and it must be recollected, of extraordinary strength. The other (the contractile powers of the muscles), although a variable one, is equally powerful during its existence ; and hence it is that this bone, under sudden and violent actions of the limb, having a very forcible degree of extension simultaneously applied, at both ends, is so frequently fractured transversely.

The condyles of the femur, as we have before stated, are received into corresponding articulating concavities, upon the head of the tibia. These depressions, in the recent subject, are considerably deepened by the semi-lunar cartilages ; so as almost to constitute imperfect *enarthrodial* articulations. The motions of the knee joint, however, are strictly *ginglymoid*, excepting

when we semiflex the leg, the ligaments being then relaxed, the tibia may be very slightly rotated upon the condyles. In extension of the leg, on the contrary, the ligaments are put upon the stretch, and not the slightest degree of lateral or rotatory motion can then be effected. In this joint very little security against accidents is afforded by the form of the bones; and compared with other large articulations, it is but little protected even by tendons, or the attachments of muscles. It is only by the ligaments, which are very numerous, that it is rendered strong; and there is scarcely any other articulation in the whole skeleton, which is so peculiarly liable to disease.

BONES OF THE FOOT.

The bones of the foot, like those of the hand, are arranged or divided into three orders, *viz.* those of the *tarsus*, *meta-tarsus*, and *toes*.

The Tarsus.

The tarsus is composed of seven bones, *viz.* the *os calcis*, *astragalus*, *naviculare*,

cuboides, cuneiforme internum, cuneiforme medium, and cuneiforme externum.

The *tarsus* is convex above, and concave below ; and in its concavity numerous muscles, vessels, and nerves, distributed to the sole of the foot, are lodged ; and by its arch-like form, defended from pressure.

The Os Calcis.

This bone, situated at the posterior and inferior part of the tarsus, is the largest of all the tarsal bones. It has an elongated and projecting process posteriorly, which constitutes the heel, but is anatomically called its head ; upon the upper part of which there is a rough surface, receiving the insertion of the tendo Achillis ; whilst inferiorly there are two tubercles or points, upon which the body rests in the erect position. The external surface of this bone is nearly flat, and presents some grooves anteriorly, for the transmission of the tendons of the peronei muscles. The internal surface, on the contrary, is much excavated, in order that the blood-vessels, nerves, and tendons of the flexor muscles may pass into

the foot, free from pressure. Upon the upper and fore-part, there are two convex articulating surfaces, the internal and most anterior of which is the smallest; by means of these surfaces, the bone is articulated with the inferior, and posterior part of the astragalus. Inferiorly, and in advance of these surfaces, there is a third, somewhat concave, by which it is articulated with the back part of the os cuboides. So that the *connexions* of this bone, are only with the astragalus, superiorly; and with the cuboid bone anteriorly.

The Astragalus,

Situated at the superior part of the tarsus, is exceedingly irregular in its figure. The upper part, called its head, is covered with an articulating surface, which is much more expanded anteriorly than posteriorly, for articulation with the lower end of the tibia. On each side of the head, there are two articulating surfaces, the internal of which is only a continuation of that covering the head, and is connected with the internal malleolus of the tibia; whilst the

external, which is of much greater extent, and descends lower than the internal, is articulated with the external malleolus of the fibula. Upon the under part of the bone, there are two other surfaces, separated by a sulcus or groove. The outermost of these, much broader, and situated more posteriorly than the other, is connected to the upper and middle part of the os calcis : the inner or anterior is also connected to a projection, upon the inner and fore-part of the same bone. The astragalus is lengthened anteriorly, by a convex process, called its second head ; which is covered with an articulating surface, for connexion with the back part of the os naviculare. The posterior surface of the bone is grooved, for the transmission of the tendon of the flexor longus pollicis. Its *connexions*, then, are as follow : superiorly, by its head, it is articulated with the lower extremity of the tibia, on each side, to the malleoli ; inferiorly and posteriorly to the os calcis ; and anteriorly to the os naviculare.

The Os Naviculare.

This bone, also termed *os scaphoides*, is rough in its whole circumference, being marked by the attachment of ligaments. It is situated in front of the astragalus, and upon the inner side of the tarsus. Superiorly, it is convex; whilst inferiorly, its form is irregular. Posteriorly, there is a large cavity, said to resemble a boat in figure, (hence its name), which is lined by an articulating surface, connecting it to the second head of the astragalus. Anteriorly the bone is convex, and is covered by an articulating surface, which is generally separated, by two prominent lines passing perpendicularly across it, into three parts; corresponding with the posterior surfaces of the three ossa cuneiformia. Sometimes there is a small surface upon the outer side, by which it just touches the os cuboides. The inferior surface of the bone has a slight projection, receiving the insertion of the tibialis posticus, and some of the tarsal ligaments.

Its *connexions* are as follow : posteriorly, it is articulated with the second head of the astragalus ; anteriorly, with the three ossa cuneiformia ; and upon its outer side, it just touches the os cuboides.

The Os Cuboides,

So named from its cubical figure, is situated upon the outer side of the tarsus, and in front of the os calcis. It is more expanded superiorly, than inferiorly, and is there rough, for the attachment of ligaments. Upon its under surface, anteriorly, there is a groove, which transmits the tendon of the peroneus longus, in its course across the sole of the foot, to its insertion upon the base of the great toe. Immediately behind this groove, there is a small flat surface, receiving one of the ossa sesamoidea. Upon its inner side there is another small surface, by which it is connected to the cuneiforme externum ; and it has two other surfaces in front, articulating it with to the meta-tarsal bones of the two last toes. Its *connexions*, then, are as follow : posteriorly, it is articulated to the lower and

fore-part of the os calcis ; on its inner side with the cuneiforme externum ; in front, it supports the meta-tarsal bones of the two outermost toes ; and also upon its inner and back part, it just touches the os naviculare.

The Ossa Cuneiformia,

So named from their wedge shape, (and certainly in the foot they strictly merit that appellation), are arranged precisely in the same manner as the stones of an arch. Of the three, the *cuneiforme internum* is much the largest, and the *medium* the least. They are situated in front of the navicular bone, upon the inner side of the tarsus. The broadest part of the cuneiforme internum is placed below, whilst the bases of the two others are above.

The *cuneiforme internum*, has an articulating surface posteriorly, *connecting* it to the fore part of the os naviculare ; it has a second articulating surface anteriorly, by which it is *articulated* with the meta-tarsal bone of the great toe, and *partially* with that of the second toe ; and it has a third surface upon its outer side, by which it *joins* the cuneiforme medium.

The *cuneiforme medium*, is more completely wedge-shaped than any of the others. Upon its back part, there is an articulating surface, by which, like the *cuneiforme internum*, it is *connected* with the navicular bone ; upon its outer side it has a second surface, which *articulates* it with the *cuneiforme externum* ; and a third upon its inner side, by which it *joins* the *cuneiforme internum* ; whilst in front it supports the meta-tarsal bone of the second toe.

The *cuneiforme internum*, is *connected* likewise to the os naviculare, posteriorly ; internally, it *joins* the medium ; and externally, the os cuboides ; whilst anteriorly it *supports* the meta-tarsal bone of the third toe, and just *touches* that of the second toe.

Formation of the Ankle Joint.

The articulation of the ankle, which is formed by the lower extremities of the tibia and fibula, and the head of the astragalus, is one of the most complete *ginglymoid* joints in the whole skeleton ; no lateral or rotatory motion being allowed, except when the foot is placed flat upon the ground, and

extended forwards ; in which case, the tibia is thrown upon the narrow, and posterior part of the head of the astragalus, and then a little of each may be effected, although it is in a very slight degree. The articulation is one of considerable strength, and is much more defended from injury than that of the knee ; particularly, by the external malleolus, which descends so much lower than the internal ; also by strong ligaments, and the passage of the tendons of the flexor and extensor muscles of the foot.

The articulations of the tarsus are strictly *arthrodial*, the bones being connected to each other by flat surfaces. Like those of the carpus, they are firmly connected to each other by strong ligaments and cartilages ; and the student will find when dissecting the ligaments, that each bone has its cartilage, its synovial capsule, and all the apparatus of a regular joint. There are, however, two distinct *articulations* in the tarsus, nearly in a line with each other, the situation of which every surgeon should be familiarly acquainted with ; as it becomes frequently necessary, in disease of some of

the tarsal and meta-tarsal bones to amputate part of the foot. The *first* of these articulations, is situated upon the inner side of the foot, between the junction of the anterior part of the os calcis, with the back part of the os naviculare. The *second*, is between the junction of the former bone, with the back part of the os cuboides. The motions of the tarsus are very properly much confined, a slight yielding being all that is allowed.

The Meta-tarsus.

This second portion of the foot, like that of the hand, is formed of five bones, which decrease in size from the second to the last. They are divided into bases, bodies, and heads. The bases are those portions which are connected by flat surfaces with the tarsal bones; the heads are convex, flattened laterally, and elongated from above downwards, so as to constitute imperfect balls, which are received into sockets upon the bases of the first row of phalanges. The bodies are the contracted and intermediate portions. These bones taken together, pre-

sent a convexity superiorly, the first and the last being situated lower than the rest ; and a concavity inferiorly, in two directions. In the first, they are concave from their bases to their heads, and in the second transversely, from side to side. Individually they are flat above, and concave below ; and their lateral surfaces are marked by sharp edges, which give attachment to the interossei muscles and ligaments. Their bases are much elongated inferiorly, so that they project farther back inferiorly, than superiorly.

The *meta-tarsal* bone of the *great toe* is the thickest, shortest, and strongest of the whole. Its base presents an oval concave depression, broader above than below, by which it is articulated with the cuneiforme internum ; and inferiorly a tuberosity, for the attachment of the peroneus longus.

The *second meta-tarsal* bone is the longest of the five, and the articulating surface upon its base, is of a triangular form, and exactly corresponds to the middle cuneiform bone, which is wedged in between the two others.

The *third meta-tarsal* bone is the next in size ; and the articulating surface upon its

base is also triangular in shape, and is larger than that upon the second bone. It is articulated with the cuneiforme externum.

The *fourth meta-tarsal* bone is nearly of the same length with the third; but the articulating surface upon its base is of a square form, and it thus corresponds with the anterior and inner part of the os cuboides; with which it is connected.

The *meta-tarsal* bone of the *little toe* which, with the exception of the first, is the shortest; is also connected by its base with the outer part of the os cuboides. Upon the external and lower side of the base, there is a projecting tuberosity, which receives the insertion of the peroneus brevis, and partly that of the abductor minimi digiti; and it also constitutes one of the chief points upon which the body rests in the erect position.

The Toes.

The toes, or last portion of the foot, consist each of three phalanges, except the first, which has but two. They are much shorter than those of the hand, but like them are

convex superiorly, and concave inferiorly ; and diminish in size from the first row to the last. They are divided into bases, bodies, and heads.

The bases of the *first row* are concave, and expanded, to be articulated with the heads of the meta-tarsal bones ; forming, as in the junction of the meta-carpal bones with the fingers, imperfect ball and socket joints ; which are so strengthened by strong capsular and lateral ligaments, that only flexion and extension are permitted. The heads of the first row exactly resemble those of the fingers in shape, having semi-circular articulating surfaces, with central depressions, forming complete trochlears or hinges, in connexion with the bases of the second row. The bodies of the first row are much more contracted in proportion to their length than those of the second.

The *second row* only differs from the first, in the bones of which it is composed, being smaller ; and in their bases, having convex articulating surfaces, with perpendicular prominences in the centre ; which are received into the central depressions, upon the heads of the first row.

The *third row* have the same peculiarities, as far as their articulation is concerned ; but are still shorter, and somewhat conical in figure ; their bodies being proportionally less contracted than those of the second row. Their anterior terminations, like those of the fingers, are rounded, rough, and scabrous.

The phalanges of the great toe, two in number, compared with the others, are of enormous thickness and strength. They are situated in the same row as the others, and are nearly equal to the three bones of the second toe, in length : they nevertheless resemble the rest of the phalanges in their mode of articulation with each other.

The articulations of the meta-tarsal bones with the tarsal are strictly *arthrodial* ; whilst those of the meta-tarsus with the first row of phalanges are *ginglymoid* ; as is likewise the case between the phalanges themselves. Very frequently, however, the two last joints of the little toe become ankylosed. The motions of the toes are precisely the same as those of the fingers, and are naturally much more free than our dress

will permit of ; hence it is, that individuals who are constantly in the habit of confining the toes suffer so much from those frightful distortions of the feet, which are the result of ankylosis of more, or less, of the phalangeal articulations.

Ossa Sesamoidea.

These bones, which are similar to those found in the hand, are so named from their resemblance to the sesamum, or oily grain. Their size, number, and situation, vary in different individuals ; but they are generally met with, as has been before stated, in parts which are much exposed to pressure. Thus, for instance, it is not uncommon to find one behind each condyle of the femur, almost always two at the ball of the great toe, and one at the same part of the little toe ; and frequently one or more also in the tendons of the tibialis posticus and peroneus longus muscles. They are invariably situated in the direction of flexion, with the exception of the patella, which belongs to this class of bones. They are inclosed by ligaments, and give attachment to the tendons of various muscles,

in their course towards their insertion. They are likewise covered with cartilage, by which means they play upon the bones with which they are articulated. Their principal use seems to be that of increasing the power of the muscles which are attached to them, by altering their direction, and thus removing them further from the axis of the bone on which they are intended to act.

The Arches of the Foot.

On examining the articulated foot, we find that the bones of which it is composed are so beautifully arranged, as to constitute two distinct arches. The first, or largest of these extends in a longitudinal direction, from the os calcis to the heads of the meta-tarsal bones. The second, or smaller, crosses the foot in the transverse direction, between the meta-tarsal bones themselves. These arches not only very considerably increase the strength and elasticity of the foot, but they also add to its figure and beauty. When it is placed flat upon the ground, they are more distinctly seen; and although it is

constructed of so many irregular bones, yet the utmost order and regularity of arrangement is observed; and strong as is their connexion with each other, they are seldom or never displaced.

CONCLUDING OBSERVATIONS.

Having completed the anatomical description of the bones, and explained the different modes in which they are articulated with each other, we shall now proceed to make a few observations, in exemplification of the advantages arising from their various forms, as are displayed in the construction of our corporeal frame; a fabric, which, though humbling to behold, is calculated to impress every sensitive mind with the most powerful feelings of admiration and reverence.

We have already stated that the skeleton is composed of three parts, *viz. head, trunk, and extremities*: that these grand divisions are severally made up of a number of bones, varying both in size and in figure; articulated to each other in different ways, all of which, however, are referable to the sub-

divisions of the articulations laid down in the diagram of *page* 13; and although so irregular in their outline, and rude in their appearance, yet most completely harmonize in their union and adaptation. Hence it is, that whilst in general they serve as a basis for the soft parts, and for supporting and directing the motions of the body, certain amongst them have a higher use, in containing those organs whose functions are most essential to life. Thus the brain is inclosed and defended by the skull; the spinal marrow, or prolongation of the brain, by the vertebral column; the heart and lungs by the ribs and sternum; and the bladder, rectum, and organs of generation, &c. by the bones of the pelvis.

In extending our investigation to the individual parts of the skeleton, we shall first direct our attention to the *head*, which consists of a variety of bones, constituting, in the first place, a large cavity, for the reception of the cerebral mass; secondly, orbitary fossæ, for the organs of vision; thirdly, nasal fossæ, frontal, splenoidal, and ethmoidal sinuses, for the developement of the

olfactory organs ; and, fourthly, foramina and canals, for the transmission of blood-vessels and nerves, supplying the several parts with vascular and nervous energy.

The union of the cranial bones is worthy of particular notice, inasmuch as it constitutes a very beautiful dome, the construction of which has an evident relation to the great principles of architecture ; and is therefore the better calculated to protect the brain from the effects of external violence. The base of this dome is principally formed by the hardest bones of the cranium, amongst which are, the sphenoid and temporal, assisted by the inferior portions of the ethmoid, frontal, and occipital bones ; the top and parietes by the parietal, frontal and occipital, and partly also by the alæ of the sphenoid bone.

Not only is the cerebral mass completely encased by this wonderful piece of mechanism, *the skull*, where nicety of adaptation is indeed in perfection ; but we also find that Nature has additionally strengthened it at those parts which are most exposed to pressure, by increasing the thick-

ness of its parietes, and by providing it with resisting spines and tubercles. Of all the provisions, however, which are displayed in the construction of the head, there is not one more beautiful, or which affords a more striking proof of that excellence and design pervading every part of the human frame, than the apparatus provided for hearing ; the constituent parts of which are enclosed within the petrous portions of the temporal bones (the hardest bones in the body), and therefore the more conducive to the production of sound. This apparatus consists, in the first place, of an auricle and an external meatus, or passage ; secondly, of a cavity, called the tympanum, having openings into it, from the mastoid cells, and the Eustachian tube ; and thirdly, of a labyrinth, which is composed of another small cavity, called the vestibule, two semicircular canals, and the cochlea.

The tympanum is separated from the auricle by a membrane, which has received the name of *membrana tympani*, and which like the parchment at the top of a drum, is attached around the edge of the meatus au-

ditorius externus, and in consequence has been familiarly styled the *drum* of the ear. This membrane is concave towards the meatus, and convex towards the tympanum. Stretched across the tympanum, is a chain of bones, constituting what is called the *ossicula auditis*. This chain is in connexion with the most convex part of the membrana tympani, upon the outer side, and with a membrane filling up an opening of communication between the tympanum and vestibule of the labyrinth upon the inner side, which opening is called the fenestra ovalis.

The vestibule, semicircular canals, and the cochlea, are all lined with a very delicate secreting membrane, which secretes a transparent fluid, called aquæ labyrinthi vel aquæ Cotunnii; and upon this very delicate membrane the filaments of the portio mollis, or that portion of the seventh pair of nerves which is exclusively distributed to the internal ear, are expanded.

The vibrations of air, collected by the various cavities of the auricle, and centred or collected together by the concha, are thence transmitted along the exter-

nal meatus to the bottom of the passage, where they strike upon the *membrana tympani*. This membrane, by the impulse thus communicated, is slightly driven inwards, pushing before it the *ossicula auditus*, which being in communication with the membrane filling the *fenestra ovalis*, the *aqua-labyrinthi* is thereby caused to undulate; and it is supposed that by the impression thus made by its undulatory movement upon the expanded terminations of the *portio mollis*, (which is increased by the peculiar nature and arrangement of the parts,) and by the same nerve conveyed to the brain, the sense of hearing is produced. It is not our intention, however, to extend our observations upon this part of our subject, not having given a description of the organs of hearing; but the student will find much to admire when he comes to study this interesting branch of anatomy. His attention cannot fail of being struck with the purity of its organization, and the elegant simplicity of mechanism displayed in its arrangement; both which afford the strongest proofs of superior skill and ingenuity.

Before however, we quit this division of our subject, we cannot forbear to notice the teeth, and to endeavour to show, as far at least as they are concerned, how wisely they are adapted for the important functions they are destined to perform. In describing them, we have already stated that they are composed of four classes, *viz.* the incisors, cuspidati, bicuspidati, and molares. In the centre of the jaws, anteriorly, are the incisors ; next, the cuspidati ; then the bicuspidati ; and lastly, the molares. The food is first received between the incisors, by which it is immediately cut or divided, and becomes lodged upon the tongue, which at the same time, by the action of muscles, is rendered concave to receive it. It is then tilted off between the molar teeth, where it is completely ground down, and being mixed up freely with saliva, is quickly fitted for deglutition. If it be of an unusually hard nature, instead of being divided by the incisors, it is received laterally, and is soon bruised or lacerated by the cuspidati and bicuspidati ; it then undergoes the same process between the molares as we have before mentioned.

The grinding motion of the jaws, however, which is so necessary to the thorough mastication of the food, could not take place were it not for the articulating surfaces upon the glenoid cavities, extending some way upon the eminentiæ articulares, which circumstance enables the pterygoid muscles to carry the jaws in a kind of rotatory movement, one across the other ; and by this simple action, which is not dissimilar to that of mill-stones, the process of mastication is effected.

Having said thus much upon the peculiar construction of the skull, we shall now direct our attention to the *trunk*, which is anatomically divided into the *spine*, *thorax*, and *pelvis*; each part of which will be considered separately.

The *spine* or vertebral column, (a most elastic structure,) viewed in its whole, may be regarded as one of the most perfect species of mechanism which has ever come under the observation of man. Here we see a number of bones, irregular in figure, so wisely adapted to and articulated with each other by a series of joints, as to constitute in their union a complete column or pillar,

not only supporting the head, but also the upper extremities and the chest : at the same time forming a continuous canal, defending and transmitting the spinal marrow ; which canal has lateral perforations, for the purpose of giving exit to the spinal nerves.

The elasticity of the spine is entirely owing to the intervention of the inter-vertebral substance, the nature of which we have before attempted to explain (*vide page 106*), and the cartilages with which their articulating surfaces are covered. These form the connecting media between the different portions of the vertebral column, and the extremely contractile qualities of the former render it susceptible of all those graceful movements for which it is so peculiarly distinguished.

The different classes of bones of which the spine is composed, are all of them admirably adapted to the performance of their particular functions. The *cervical*, which are the smallest and most moveable, taper gradually from below, upwards, and are abundantly supplied with inter-vertebral matter, whereby the sphere of their action

is much extended beyond that of either of the other classes.

The two first of these bones, which are entirely different both in figure and peculiarities from the rest, deserve particular attention. The *atlas*, as we have before seen, is a mere bony ring, having its superior articular processes excavated, in order to receive the convex condyloid processes of the occipital bone, to which they are most perfectly adapted. Its inferior articular processes are flat, corresponding with the superior of the *dentata*, upon which they glide with the utmost possible facility. These bones are both retained in their situation by ligaments and two different sets of muscles ; and in the nodding movements of the head, which take place solely between the atlas and occipital bone, only one set is called into action ; and during that action, the atlas becomes a fixed point, being firmly retained in its position at the summit of the spine, until the contraction of the muscles has ceased. On the contrary, during the rotatory movements of the head, the atlas is strongly affixed to the occiput, and the

condyloid processes of the latter bone being accurately fitted into the articular processes of the former, the head, by the conjoined action of the recti and oblique muscles, is rolled round upon the shoulders of the dentata ; so that under one particular movement the atlas remains fixed to the occiput ; and under another to the dentata, both which are completely subjected to voluntary controul.

Extensive, however, as is the degree of motion permitted by these articulations in particular (and especially the rotatory, which is so great as to allow of the face being turned nearly parallel with the clavicle,) and curious as is the disposition of the articulating surfaces, by which that motion is rendered effective ; yet is the spinal marrow transmitted through the very centre of these bones, and along the whole track of the vertebral channel, uninjured or uncompresssed ; sending forth from each side, through the inter-vertebral foramina, bundles of nervous ramifications to be distributed to the various parts of the body, and to communicate with the ganglionic sys-

tem. And so strong are the ligaments by which the bones are tied together, that there has not been a single instance on record, of death occurring from rupture of these parts, when in a healthy condition, during the common movements of which they are susceptible. If it be asked, how is this prevented? we refer the reader to the bones themselves. We have already pointed out their peculiarities, (*pages 99 and 100,*) and shown how one bone is articulated with another; that the dentiform process of the dentata is threaded as it were, by the atlas; that the top of this process is tied by ligament to the edge of the foramen magnum, and is prevented retreating from its connexion with the forepart of the ring of that bone internally, by the transverse ligament, which is so strong that it has never been known to give way, except from disease, or the application of unnatural force.

But passing from individual bones, we proceed to notice the great mobility of the cervical portion of the vertebral column, compared with that of the dorsal or lumbar portions, independent of the nodding and rotatory

movements we have been speaking of ; and to enquire what is the disposition which so peculiarly favours such mobility, and at the same time renders it as compatible with safety to the spinal marrow, as if no such mobility existed. The first part of our enquiry is already answered, by the consideration of the increased quantity of the intervertebral substance which we find deposited between the bodies of the cervical vertebræ, in proportion to their size, than between those of the dorsal and lumbar vertebræ. The latter part, as in the former case, can only be explained by a reference to the bones themselves ; the bodies of which, as has been stated in their anatomical description, are hollowed above from side to side, and below from before backwards ; so that they become as it were mutually clasped, and are besides covered by a ligamentous expansion, both anteriorly and posteriorly, which is extended throughout the whole length of the vertebral column, not only rendering their connexion stronger, but also restraining their mobility ; and when the head is bent forwards, the retreat of the

inter-vertebral substance backwards, makes way for the anterior lip of the inferior surface of a vertebra above, to overlap and hitch against the excavated edge of a vertebra below. The same circumstance occurs in the opposite direction, when the head is thrown backwards; so that whilst the particular shape of the bones and the intervention of the inter-vertebral substance, facilitates the flexion and extension of the neck, the ligamentous expansion, anteriorly and posteriorly, prevents its being carried to a degree, which would be likely to endanger luxation. Such an arrangement affords but another striking proof of that excellent skill and surpassing ingenuity, pervading every part of our corporeal frame.

There is yet one more striking peculiarity in the bones of the neck, which does not exist in any other portion of the vertebral column. We allude to the foramina of the transverse processes, which we find in the articulated skeleton, forming continuous canals, extending throughout the whole of the neck, for the purpose of transmitting the vertebral arteries. The vessel of either side enters the

foramen of the sixth cervical vertebra, and traverses the canal formed by the junction of the cervical bones, till it reaches the upper surface of the atlas. It then continues its course along the groove we have described, as winding behind the superior articular processes of the atlas, and enters the skull through the foramen magnum. It passes a short distance forwards, upon the basilar process of the occipital bone, and then unites with its fellow to form the basilar trunk, one of the principal vessels supplying the brain with blood. The utility of such tortuous channels is too obvious to be mistaken, when we recollect with what force under increased exertions; and especially in motions of ascent, the blood is propelled into the delicate vascular meshwork of the brain; the vessels of which, must be constantly in danger of rupture, were it not for the resistance which these crooked and bony channels afford to its impetus. We have another beautiful example of the same wise provision of nature, in the tortuous course of the carotid arteries, which, though shorter in extent, is admir-

ably well calculated to answer the same important purpose.

The dorsal portion of the spine, although partaking of the general peculiarities of other vertebræ, has, nevertheless, distinguishing characteristics, which, like those of the first class, are destined to the performance of separate and particular functions. What those characteristics are, it is now for us briefly to investigate; and we shall presently see, that they will lead us to a few considerations, as interesting as any that have yet come under our notice.

In the first place, the vertebræ of the back are conspicuous from the rest, in the length and course of their spinous processes, which are most appropriately designated. Instead of appearing, as in the neck, mere bifid projections, they here present considerable elongations of the vertebral arches, passing in the upper part of the back obliquely downwards, and in the lower portion nearly perpendicularly so, with the exception of the two last, which, as they approach the lumbar vertebræ, become nearly horizontal; having acute and raised ridges superiorly,

and elongated excavations inferiorly; and when the different bones are approximated with each other, the ridge of one vertebra, is over-lapped or concealed by the elongated excavation of another; and consequently the greater, or central portion of the back is rendered comparatively immoveable, whilst at the same time it constitutes a firm pillar, to which, the principal muscles influencing the movements of the head and upper portion of the spine, are attached.

Secondly, the articulation of the ribs with the vertebræ, independently of the decreased quantity of inter-vertebral matter deposited between their bodies, is sufficient to account for the comparative immobility of this portion of the vertebral column. It will be remembered that in our anatomical description of these bones, we stated that their heads possessed two small articulating surfaces, separated, by an oblique ridge, which ridge was received between the bodies of two adjoining vertebræ. It must be obvious then, even to the most casual observer, that if any thing like an extended degree of motion was permitted in the dorsal portion of the

vertebral column, the ribs would be in constant danger of displacement. Consequently all the motions that we find it susceptible of, are slight flexion and extension, to which actions the ribs, through the elasticity of their cartilages, as far as is necessary, readily accommodate themselves.

The third peculiarity in the vertebræ of the back, is the amazing size and thickness of the transverse processes, (compared at least with those of the cervical vertebræ,) which in like manner as the spinous processes appear to be elongations of the centre of the vertebral arches, so these appear to be extensions of their sides, ascending obliquely upwards and outwards. Their principal use seems to be that of strengthening the articulations of the ribs with the spine, the tubercles of the former being strongly connected both by ligament and cartilage, to the anterior extremities of the latter. Besides which, by partially projecting between the inter-costal spaces, they materially defend the dorsal region of the thorax, and afford strong points for the attachment of the immense masses of muscle filling those longitudinal hollows upon

each side of the spinous processes, which are so conspicuous in the articulated skeleton.

The peculiarities of the lumbar portion of the spine, we have so fully dwelt upon in its anatomical description, that we need not enlarge here. It will be sufficient to take notice, first, of the comparatively increased size of these vertebræ, which the better enables them to support the superincumbent weight of the body: secondly, the increased deposition of the inter-vertebral substance, a provision which accounts for their greater mobility: and thirdly, the disposition of the articular surfaces, which the student will find face laterally, or alternately from and towards each other; whilst those of the dorsal, it will be recollected, face backwards and forwards. This lateral arrangement of these surfaces, allows of a slight degree of lateral or rotatory motion, which we have already alluded to, when speaking of the motions of the spine. The transverse processes pass horizontally outwards from the sides of the arches, and are so long and slender, that they appear almost to form very short ribs, filling up in

some measure, the osseous deficiency between the under edges of the last ribs on each side, and the spines of the ilea. In the recent subject we find them completely imbedded amongst the lateral abdominal muscles, to which they principally give origin.

Having advanced thus much upon the different classes of bones, of which the spine is composed, and endeavoured to trace the connexion between their peculiarities and the performance of particular functions; we shall now proceed to notice the vertebral column, in its whole, as it appears in fact, when dis-articulated from the ribs and the pelvis.

We have already stated that when viewed laterally, and in the perpendicular direction, it presents several advances and recessions in its course downwards, which, in addition to giving support to some of the viscera, and affording space for others, by increasing the size of the cavities containing them, add most materially to its strength, and thereby better enables it to bear up against the amazing weight which is appended to it. We have also shown that it is composed

of two pyramids or cones, which meet at their bases. The upper and largest consisting of true vertebræ, supports the head, upper extremities, and the chest; whilst the lower, which, if straight, would strictly deserve the appellation, completes the pelvis posteriorly, between the bones of which it is wedged, like the keystone of an arch; and in the erect position of the articulated skeleton, when the situation of the pelvis is naturally oblique, its articulation with the ilea is such, that the centre of gravity appears to traverse the substance of the ilea, from the posterior part of the linea ileo-pectinea upon each side, to the outer and upper portions of the acetabula, which are beautifully supported by the corresponding portions of the heads of the femurs. So that if a line could be drawn, indicating the manner in which the weight of the body is transmitted to the lower extremities, it would extend in an oblique direction from the sides of the sacrum, through the substance of the ilea, just where those bones join the ossa pubes, to the very centre of those portions of the former bones, constituting the deepest part of the acetabula.

The arrangement of the individual portions of the spine, has an evident relation to the purest principles of architecture. In one division we find these portions thicker anteriorly than posteriorly, and *vice versa* in another; some having a great quantity of the inter-vertebral substance interposed, others but a very little, and hence those projections and incurvations, which in the articulated skeleton, not only serve the important purposes we have mentioned, but also add to its strength and beauty. So strong indeed is it, that it may be said to form the central pillar of the human frame, upon the stability of which all the other movements are dependant; whilst at the same time, its being composed of so many different and detached pieces, merely appended to each other by ligament and cartilage, give it an inconceivable degree of mobility, perfectly compatible with safety to the important structure it encloses throughout its whole extent; and at the same time renders it, one of the most beautiful pieces of mechanism in our corporeal frame.

We now pass on to the consideration of the second division of the trunk, the *thorax*. This cavity, although the largest in the body, is, properly speaking, imperfect on every side, except in the recent subject, in which we find the inter-spaces completely filled up by ligaments and muscles, and the whole lined with an exceedingly dense membrane, the pleura. In figure, it is strictly conical, the base of the cone, looks towards the abdominal cavity, and in the recent subject, is separated from it only by the diaphragm; the apex is formed by the lower cervical vertebræ and the first portion of the sternum. Its form, internally, in whatever way we regard it, is arched, or somewhat circular, a circumstance which the better enables it to bear up against the pressure of the atmosphere, which is very great, (especially when we recollect that every square inch supports a column of atmospheric air equal to *fifteen pounds in weight*,) as well as to resist the effects of external violence. Indeed were it not for the manner in which the ribs are articulated with the spine, the elasticity and yielding nature of the carti-

lages by which they are connected with the sternum, and their individually arched form, injuries comparatively slight in their nature, would much oftener be attended with serious results; whereas numerous instances are on record, of immense weights having passed over the chest, and yet the individuals who were the subjects of such frightful accidents have escaped with merely cellular and muscular contusions. It is a singular fact however, that the application of a comparatively slight degree of force to a single rib has more frequently been productive of fracture than when it has been applied to several at once. This is easily accounted for when we come to recollect, that it is unaided in its resistance by any of the others, and hence it is, that persons receiving blows from the fist, or any hard projecting body, have one or more of their ribs so readily broken.

The whole form of the thorax is admirably adapted to the organs of expansion it is destined to contain, for not only do the rib and sternum present an uniform concave surface internally, but even the very

spine itself recedes considerably backwards in the centre; and this concavity, during the function of respiration, is greatly increased by the ascent of the ribs, and by their under edges becoming everted, as we have already stated, when speaking of their movements. The diaphragm however, forms a notable exception to this arrangement, but one which is equally subservient to the performance of respiration. This muscular partition, when relaxed, is convex towards the thorax, and concave towards the abdomen; but during its action, which is co-existent with that of the ribs, it becomes an inclined plane, directed downwards and forwards, and at that instant the abdominal viscera are pressed against its parietes, and the cavity of the thorax is thereby considerably deepened.

Of the *pelvic cavity* its divisions, apertures, and articulations we have already dwelt so fully upon when describing the bones of which it is composed, that it will be needless for us to enlarge here, except to notice its position in the articulated skeleton, which is so oblique that the weight

of the whole of the upper part of the trunk, after being received upon the base of the sacrum, appears to be conveyed in a diverging direction along the anterior alæ of the sacrum, and posterior portions of the lineæ ileo pectineæ to the heads of the femurs; thus it may be truly said to constitute the base of the trunk. It is entirely owing to this oblique, nay, we had almost said perpendicular position of the pelvis, more particularly of the ossa innominata, that man's position is rendered so upright, his figure so graceful, and progression so sure.

It was our intèntion, before concluding the present remarks to have extended our observations to the mechanism of the extremities; but having said so much upon the formation and movements of the different articulations when describing the bones, and it being desirable not to extend the work beyond its present limits, especially as it is designed for a pocket *manual*, we must forbear. Meanwhile we both hope and trust that the expositions we have attempted to give of the advantages arising from the peculiar forms of the bones, and the

manner in which they constitute the various cavities we have spoken of, may not prove altogether useless, in directing the attention of the student in his leisure hours, to the contemplation of the beautiful frame work of that structure, which considered in its whole, has been so justly and emphatically styled

“ Creation’s masterpiece ! ”

FINIS.

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Dragon.

Dragon

Dragon-fly.

George Some

George Some

George Jones

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Gons

